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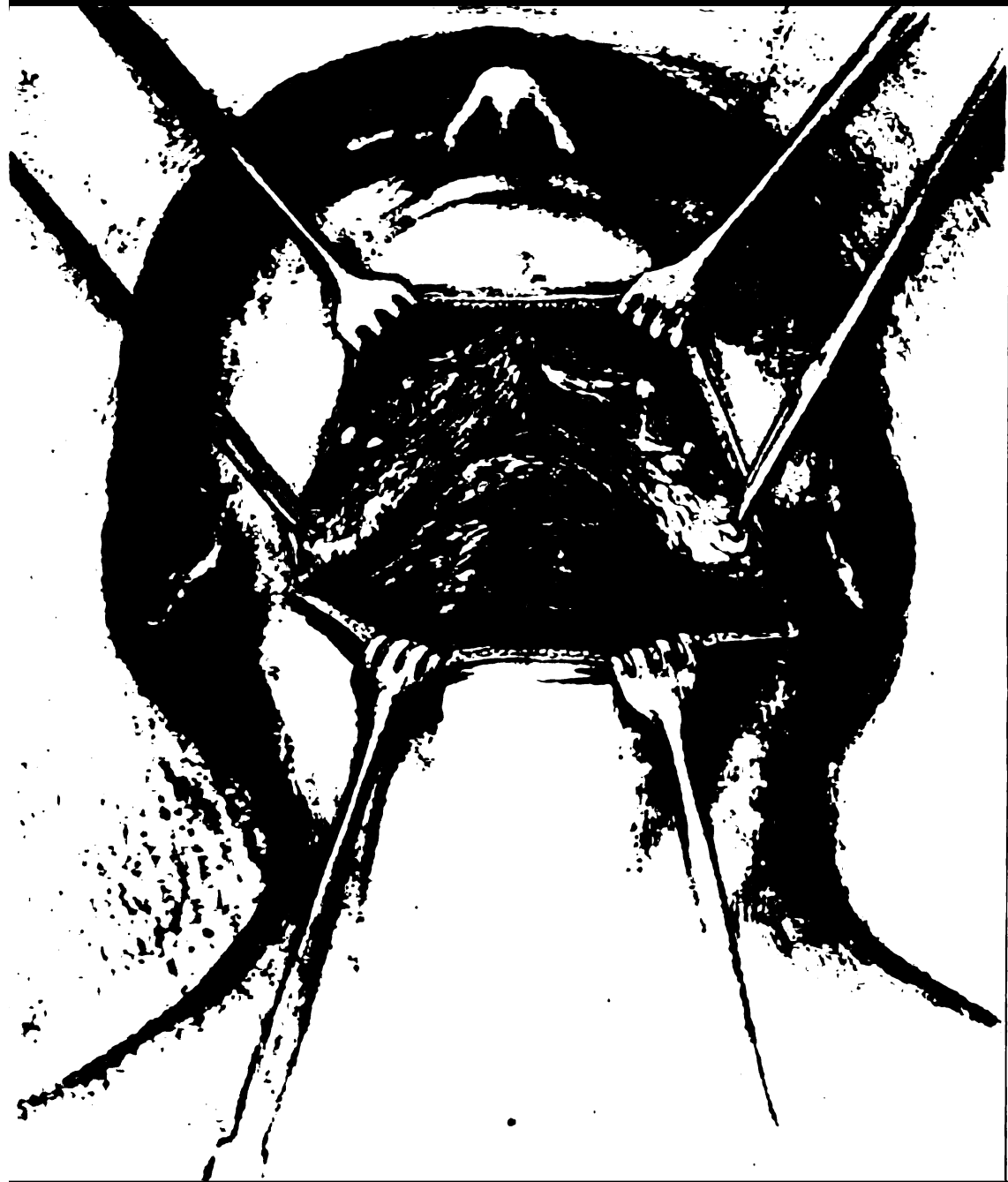
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*Collected papers by the staff of
Saint Mary's Hospital, Mayo Clinic*

Saint Marys Hospital (Rochester, Minn.)

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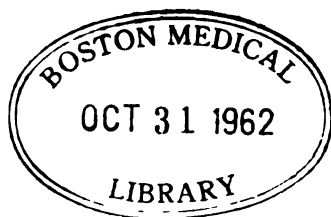
**St. Mary's Hospital
Mayo Clinic**

**Rochester, Minnesota
1905-1909**



**PHILADELPHIA AND LONDON
W. B. SAUNDERS COMPANY**

1911



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PRINTED IN AMERICA

FOREWORD

Many of the papers herein collected have been read before various medical societies, and all of them have been published in current medical literature. Our chief reason for bringing them together in the present form is for our own convenience of reference; an object which has been greatly furthered by the detailed index supplied by the publishers. Our first plan was to have the papers printed for private distribution only, but at the instance of numerous members of the medical profession we have consented to having the book placed on the market. We trust that it will be accepted for just what it purports to be, namely, an indexed collection of reprints.

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February, 1911.

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CONTENTS

ALIMENTARY CANAL		PAGE
EPITHELIOMA OF THE LIP.....		3
DIVERTICULA OF THE ESOPHAGUS, WITH A REPORT OF SIX CASES.....		11
CARDIOSPASM, WITH REPORT OF CASES.....		21
CARDIOSPASM, WITH A REPORT OF FORTY CASES.....		33
GASTRIC ULCER AND CANCER.....		50
CONTRIBUTIONS OF SURGERY TO A BETTER UNDERSTANDING OF GASTRIC AND DUODENAL ULCER.....		58
DIFFERENTIAL DIAGNOSIS BETWEEN DUODENAL ULCER AND GALL-STONE DISEASE.....		68
RELATION OF THE MESOCOLIC BAND TO GASTRO-ENTEROSTOMY.....		76
A STUDY OF GASTRIC AND DUODENAL ULCERS, WITH ESPEC AL REFERENCE TO THEIR SURGICAL CURE.....		81
HEMORRHAGE FROM THE STOMACH AND DUODENUM.....		95
CHRONIC ULCER OF THE STOMACH AND DUODENUM.....		102
CANCER OF THE STOMACH.....		111
PROMINENT SYMPTOMS IN THE DIAGNOSIS OF GASTRIC AND DUODENAL ULCERS.....		124
VALUE OF THE TEST-MEAL IN GASTRIC DIAGNOSIS.....		131
PATHOLOGIC RELATIONSHIPS OF GASTRIC ULCER AND GASTRIC CARCINOMA.....		139
DIAGNOSIS OF GASTRIC ULCER, WITH DIFFERENTIAL DIAGNOSIS.....		169
DIFFERENTIAL DIAGNOSIS OF GALL-STONES, ULCER AND CANCER OF THE STOMACH.....		179
DIFFERENTIAL DIAGNOSIS OF DISEASES CAUSING GASTRIC DISTURBANCE.....		188
ULCER OF THE DUODENUM, WITH REPORT OF TWO HUNDRED AND SEVENTY- TWO OPERATIONS.....		194
ANEMIC SPOT ON THE DUODENUM WHICH MAY BE MISTAKEN FOR ULCER.....		203
PANCREATITIS RESULTING FROM GALL-STONE DISEASE.....		205

	PAGE
THE SURGICAL TREATMENT OF PANCREATITIS	214
CYST OF THE ROUND LIGAMENT OF THE LIVER	228
SURGERY OF THE LARGE INTESTINE, WITH A REVIEW OF ONE HUNDRED RE- SECTIONS	231
TUMORS OF THE CECUM	260
RESECTION FOR THE RELIEF OF INTESTINAL OBSTRUCTION	268
CONGENITAL IDIOPATHIC DILATATION OF THE COLON: "HIRSCHSPRUNG'S DISEASE"	274
VALUE OF SONDERN'S DIFFERENTIAL LEUKOCYTE RESISTANCE-LINE IN THE DIAGNOSIS AND PROGNOSIS OF ACUTE APPENDICITIS	280
ACQUIRED DIVERTICULITIS OF THE LARGE INTESTINE	294

HERNIA

RADICAL CURE OF UMBILICAL HERNIA	321
INGUINAL HERNIA—TYPES OF OPERATION—RESULTS IN 1652 CASES	328
MESOCOLIC OR RETROGASTRIC HERNIA	337
DIAPHRAGMATIC HERNIA, WITH REPORT OF THREE CASES	342
RETROPERITONEAL LIPOMA	348

GENITO-URINARY ORGANS

TRANSPERITONEAL REMOVAL OF TUMORS OF THE BLADDER	355
TUMORS OF THE BREAST, WITH SPECIAL REFERENCE TO OBTAINING BETTER RESULTS IN MALIGNANT CASES	363
TUMORS OF THE BLADDER	369
TRANSPERITONEAL OPERATION FOR REMOVAL OF BLADDER NEOPLASMS	375
CONGENITAL UNILATERAL ABSENCE OF THE UROGENITAL SYSTEM	385
RELATION OF ANOMALOUS RENAL BLOOD-VESSELS TO HYDRONEPHROSIS	392
SOME DATA ACQUIRED WITH THE AID OF THE URETERAL CATHETER	408

DUCTLESS GLANDS

TREATMENT OF THE POSTERIOR CAPSULE OF THE GLAND IN THYROIDECTOMY, BASED ON THREE HUNDRED AND SEVENTY-FIVE OPERATIONS FOR GOITER	419
GOITER, WITH PRELIMINARY REPORT OF THREE HUNDRED OPERATIONS ON THE THYROID	427

CONTENTS

ix

	PAGE
GOITER: ITS SURGICAL TREATMENT BASED ON FOUR HUNDRED AND SEVENTY-FIVE CASES.....	441
THE PATHOLOGIC CHANGES IN THE THYROID GLAND, AS RELATED TO THE VARYING SYMPTOMS IN GRAVES' DISEASE; BASED ON THE PATHOLOGIC FINDINGS IN TWO HUNDRED AND NINETY-FOUR CASES.....	449
THE PATHOLOGIC RELATIONSHIPS OF EXOPHTHALMIC AND SIMPLE GOITER...	478
MORTALITY AND LATE RESULTS FROM THYROIDECTOMY IN EXOPHTHALMIC GOITER OR HYPERTHYROIDISM.....	496
A CONSIDERATION OF THE MORTALITY IN ONE THOUSAND OPERATIONS FOR GOITER.....	498
THE PARATHYROID QUESTION.....	504
THE OPERATIVE TREATMENT OF HYPERTHYROIDISM.....	508
LIGATION OF THE THYROID VESSELS IN CERTAIN CASES OF HYPERTHYROIDISM..	515
THE REVERSION THEORY AND CLASSIFICATION OF GOITER.....	523

HEAD AND EXTREMITIES

PERIPHERAL VERSUS INTRACRANIAL OPERATIONS FOR TIC DOULOUREUX.....	541
THE TREATMENT OF CANCER OF THE FACE, HEAD, AND NECK.....	547
A METHOD OF OPERATION FOR UNUNITED FRACTURE.....	553
THE SURGICAL TREATMENT OF BUNION.....	558

ANESTHETICS

A REVIEW OF OVER FOURTEEN THOUSAND SURGICAL ANESTHESIAS.....	567
--	-----

TECHNIC

A METHOD FOR THE RAPID PREPARATION OF FRESH TISSUES FOR THE MICROSCOPE.....	579
OPERATING-ROOM TECHNIC.....	581
STEREO-PHOTOGRAPHY OF PATHOLOGIC SPECIMENS: SOME IMPROVEMENTS IN TECHNIC, AND NEW APPARATUS.....	589

GENERAL PAPERS

PRESIDENT'S ADDRESS.....	601
PRESENT-DAY SURGERY IN ENGLAND AND SCOTLAND; FROM NOTES MADE ON A RECENT SHORT VISIT.....	605

	PAGE
SOME PRACTICAL POINTS IN THE PHYSICAL EXAMINATION.....	617
A PLEA FOR THE EARLY DIAGNOSIS AND EARLY SURGICAL TREATMENT OF CANCER.....	623
BIER'S CONGESTIVE THERAPY.....	628
— — — — —	
INDEX OF CONTRIBUTORS.....	635
BIBLIOGRAPHIC INDEX.....	639
INDEX OF SUBJECTS.....	643

ALIMENTARY CANAL

EPITHELIOMA OF THE LIP *

By E. S. JUDD

The ability of a surgeon to treat malignant diseases satisfactorily depends more upon an early diagnosis of the trouble than upon any other factor.

Cancer of the stomach and intestines, if so situated as to give rise to symptoms early before the glands are extensively involved, can be removed with a good percentage of cures, and cancer of the breast, if taken before the axillary glands are affected, can be cured in 80 per cent. of the cases, according to the recent report of Halsted.

Cancer of the lip, no matter whether it begins as a wart, ulcer, excoriation, tubercle, or leukoplakia, can be diagnosed positively within a few weeks, during which time the epithelial cells have changed but little from the normal, the glands have not become involved, and the growth is comparatively benign. Because the epithelial cells are slow to change their shape and regularity, and because the extension to the lymphatics is also slow, the advancement in the treatment of cancer in this region has not kept pace with the treatment of cancer in other localities.

The removal by paste and caustics, though now considered an act of malpractice in all other types of cancer, is still employed to a considerable extent in cancer of the lip, and with the exception of the deformity, the results are as good as those obtained by the surgeon who simply snips out the growth.

Oftentimes the disease does not manifest itself in the glands for many months, and sometimes not for several years after it starts

* Read before the Sioux Valley Medical Society, January, 1908. (Reprinted from "The Old Dominion Journal of Medicine and Surgery," vol. vii, No. 5, Nov., 1908.)

in the lip, and the patient is apt to consider the lump in the neck a new disease instead of an extension of the former trouble of the lip. Very frequently patients come under treatment for tumors of the neck who do not mention the ulcer of the lip they had a year or two before. As this was removed with paste and healed readily, they do not suspect that the swelling in the neck is a cancer recurring from the malignant ulcer in the lip.

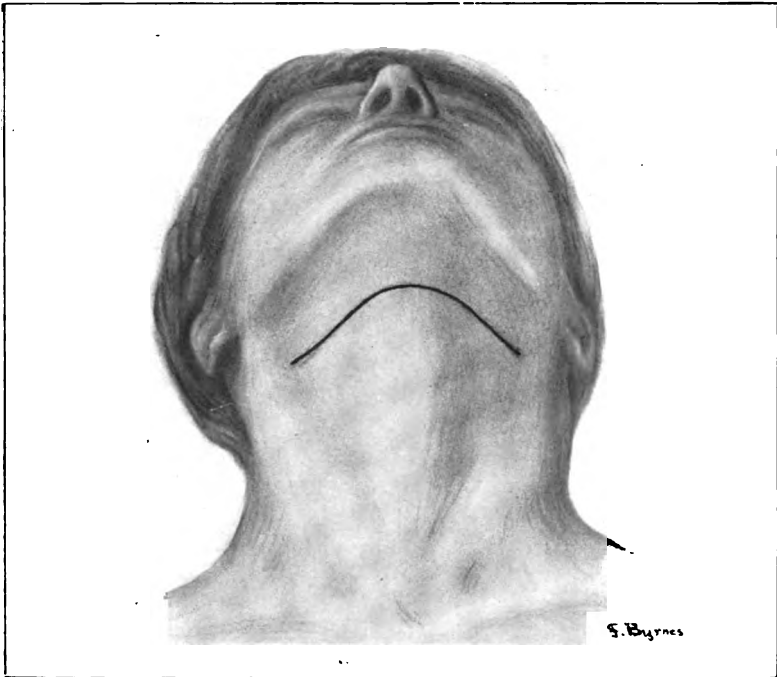


Fig. 1.—Line of incision avoiding lower branches of the seventh nerve.

It makes no difference how early a case of cancer of the breast is operated upon, the surgeon should not risk his reputation by simply removing the breast and leaving the glands, whether or not they are involved, and the same care should be exercised regarding the submental and submaxillary glands in dealing with cancer of the lip.

Diagnosis.—The lower lip is very rarely the seat of any form of

malignant disease other than epithelioma—squamous-celled carcinoma. During the first few weeks of the growth it is difficult to tell, clinically, the difference between the malignant and benign

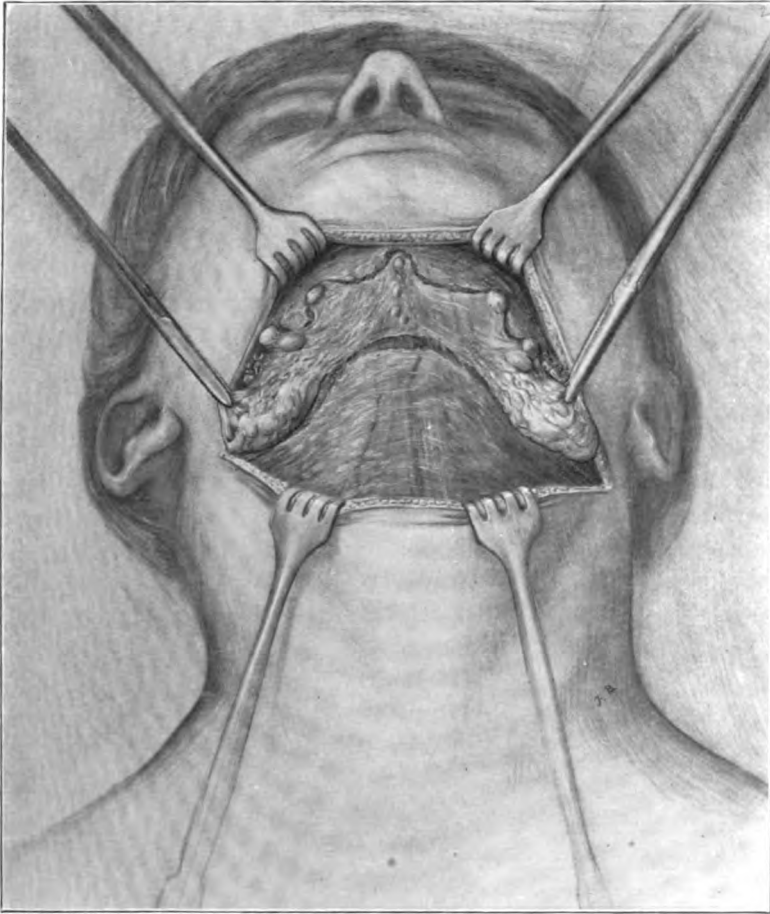


Fig. 2.—Gland bearing fascia containing submaxillary salivary glands, submaxillary lymph-nodes and submental lymph-nodes.

ulcer, which is usually specific. The specific ulcer is more frequently seen in young people of the female sex. It usually appears on the upper lip and the glands will early become enlarged, the secondary symptoms showing in a few weeks.

We can prove our diagnosis by waiting several weeks for the secondary symptoms to appear or the non-specific ulcer to heal, but during all these weeks we are losing valuable time and keeping the patient in suspense as well. Any ulcer of the lower lip which does not heal promptly should be considered suspicious, and it will be far better to excise and have it examined microscopically than to await developments. This procedure is necessary only in uncertain cases; if the ulcer is benign, no harm is done, and if it is malignant, a great deal is accomplished because the radical operation can be done without delay.

As to whether the glands are already involved, the most experienced surgeon cannot say until they have been removed. It is often impossible to palpate enlarged glands in the neck, and if they are palpable it is difficult to tell whether they are inflammatory or malignant.

Growth and Extension.—In the majority of cases the growth starts on the prolabium at a point between the angle of the mouth and the median line. Beginning as a superficial growth, extension takes place on the mucous membrane and skin, and the increasing induration shows involvement of deeper tissues. The lymphatic vessels of the lip are divided into the submucous and the subcutaneous. The submucous vessels, two or three in number, pass directly to the submental and submaxillary glands of their respective sides, but the subcutaneous vessels, two to four in number, sometimes pass across to the glands of the opposite side and intercommunicate with each other. For this reason it is necessary to remove the glands from both sides even though the growth is distinctly in one half of the lip, and especially if it involves the skin surface.

The submental group of glands is composed of from two to four glands lying just beneath the center of the lower jaw between the two anterior bellies of the digastric muscles. The submaxillary group is made up of from three to six glands along the lower border of the lower jaw, extending as far as the angle of the jaw. One or more of these glands lies within the submaxillary salivary gland, or is so closely connected with it that it is impossible to

remove all the lymphatic glands and save the submaxillary. The deep cervical chain is never involved except secondary to the submental or submaxillary glands.

Aside from the fact that the growth is naturally slow to involve the glands, another feature in favor of the cure of these cases is the single route of lymphatic drainage which is completely accessible. With this one lymphatic chain removed there are no other avenues for the cells to travel.

From a report by Crile we see that four times as many of his cases of cancer of the head and neck have remained well since he made a block dissection of the lymphatics. Halsted shows that the cures in cancer of the breast in cases before the lymphatics are involved are from 80 to 90 per cent. If operation is delayed until the axillary glands show involvement the percentage of cures drops to less than 25 per cent.

Report of Cases.—The total number of cases of cancer of the lip operated upon at St. Mary's Hospital, Rochester, Minnesota, up to January 1, 1908, is 156. In all but three cases the growth started on the lower lip. In three the upper lip was involved. In this series, 5 cases were in the female, 12 cases were under thirty-five years of age, 48 cases from thirty-five to fifty years, and 95 of them were over fifty years, four of these being over eighty. The youngest patient was twenty-one years old. In this case the glands were thoroughly removed and he has now been well nearly three years. Thirty-three of the cases had been operated upon locally, and had recurrence at the time of the second operation. One hundred and thirteen of the 156 cases have been traced. In 24 of the earlier operations the glands were not removed. Six of these are known to have been without recurrence over three years. In 132 cases the glands were removed, and in 33 of these the involvement could be demonstrated. Of the 132 cases, 104 have been traced. Three died in the hospital, two of pneumonia and one of nephritis. Seven have died of recurrence and eight of other troubles. Forty-four of the traced cases, in which the glands were removed, were operated upon over three years ago, and of these 30 are alive and have had no recurrence. Three died of

recurrence, one, two, and three years later. Six, having lived more than three years following operation, have died of other troubles. Out of 44 cases all but 3 lived over three years without recurrence, and one of the three that died was a recurring case at the time the radical operation was performed.

Technic.—The head of the table is elevated somewhat to allow

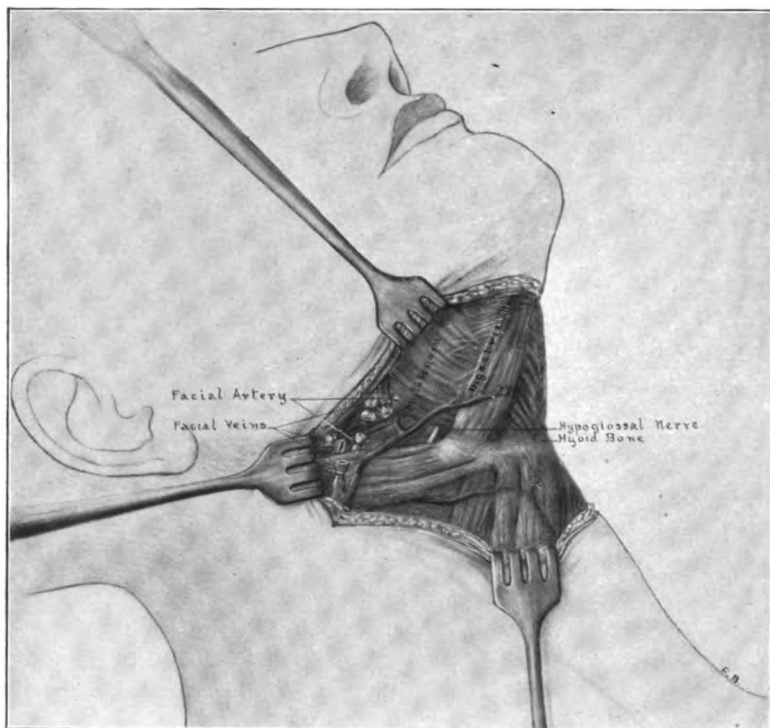


Fig. 3.—Fascia, including gland, has been removed.

the blood to gravitate from the veins of the head and neck. A collar incision is made (Fig. 1) $1\frac{1}{2}$ inches below the lower jaw and parallel to it, in the natural creases of the neck, extending from the anterior border of the sternomastoid muscle on one side to the anterior border of the same muscle of the opposite

side. This incision cuts the skin and platysma, and in this line the lower branches of the facial nerve will be avoided, and the nerve will be reflected with the skin and platysma flap to the level of the jaw. This exposes the submaxillary and submental gland areas. It is most convenient to start the dissection in the middle line, carrying the group of submental glands and the gland-bearing fascia to one side, continuing across the anterior belly of the digastric, and taking all the submaxillary lymphatics and submaxillary salivary glands in one block (Fig. 2).

We have seen no involvement of the salivary glands in these cases, but the association of the lymphatics and salivary glands is too close, and the inconvenience caused the patient by the loss of them too slight to warrant saving them. In only the advanced cases will the deep cervical glands be involved, but if they are, it will necessitate extending the incision down on either side and removing that group as well. It is best in all cases to remove the glands from both sides of the neck because of the intercommunication of the lymphatic vessels (Fig. 3).

The only structure to be especially avoided is the hypoglossal nerve. This will be seen passing into the tongue muscles just behind the anterior belly of the digastric. No great harm will come from injury to one nerve, but destroying both means a complete paralysis of the tongue and pharynx, and inability to swallow.

A small stab drain is put into the submaxillary spaces and the skin incision closed after the platysma has been sutured. This incision made in the natural crease of the neck and closed with a subcuticular stitch after the platysma has been carefully closed, will leave a line scar that will be scarcely noticeable in a few weeks.

A V-shaped incision to remove the growth from the lip will answer in the early cases. The incision should not be closer than one-half inch to the growth at any point, and if a greater part of the lip is removed it will be necessary to swing the cheeks in and make a new lip from these. Some surgeons advocate removal of the growth and glands in one piece. This directly

exposes the tissues of the neck to infections from the mouth, and does not seem necessary. In none of our cases have we seen recurrence in the lymph-vessels between the growth and the glands.

These patients are up and around the day following the operation, and will be uncomfortable only in that it is difficult to swallow for the first few hours. The drains are removed as soon as the serum stops discharging, usually in four days. These patients remain in the hospital from three to five days and are able to take up their work in a few weeks.

DIVERTICULA OF THE ESOPHAGUS, WITH A REPORT OF SIX CASES *

By H. S. PLUMMER

Within the last five years a wide-spread interest in diseases of the esophagus has sprung up. This is due largely to a recognition of the therapeutic possibilities in idiopathic dilatation and diverticula of the esophagus. The diagnosis of esophageal diseases attracted the attention of but few men as long as these lesions were looked upon as curiosities offering little more than palliative relief from treatment. Because of the technical character of the work, the accurate diagnosis and treatment of esophageal lesions will fall largely under the care of those men who elect to take special interest in this line of work; but the general practitioner should become familiar with their clinical recognition.

In this paper the etiology and pathology of esophageal diverticula will not be gone into further than is essential to introducing the subjects of diagnosis and treatment.

Rokitansky, in 1840, classified esophageal diverticula, from an etiologic standpoint, into two groups:

1. Those arising from traction without the esophagus he called traction diverticula.

2. Those arising from pressure within he called pulsion or pressure diverticula.

Oekonomides added a third group, *traction-pressure diverticula*. In this class, as the name indicates, the traction diverticulum becomes enlarged by pressure from food accumulating within its cavity.

* Read at the fortieth annual meeting of the Minnesota State Medical Association, held at St. Paul, October 6 and 7, 1908. (Reprinted from the "Journal of the Minnesota State Medical Association and the Northwestern Lancet," June 15, 1909.)

On anatomic and clinical grounds, diverticula may be grouped into:

1. Pharyngeal diverticula.
2. Pharyngo-esophageal diverticula.
3. Diverticula of the middle third of the esophagus.
4. Deep-seated diverticula, or those in which the origin of the diverticulum is below the level of the left bronchus.

The probable origin of most cases of pharyngeal diverticula is from remains of the third and fourth branchial clefts. Other congenital defects, trauma, and peripharyngeal inflammatory processes may also give rise to diverticula.

The pressure or pulsion diverticulum of Zenker is of the most clinical importance. It originates on a level with the cricoid cartilage, at what is known as the Lanier-Hackermann point on the posterior wall at the juncture of the pharynx and esophagus.

Diverticula of the upper third of the esophagus, below the pharyngo-esophageal juncture, are rare and belong to the traction or traction-pulsion variety.

The third group described by Leutgert originates on the anterior wall of the esophagus just above the left bronchus. He describes a slight recess in the anterior wall immediately above the point where the left bronchus rests on the esophagus, and attributes the formation of diverticula at this point to the slight obstruction offered to the passage of large boli of food, and the tendency of food to lodge in this recess.

Very few instances of deep diverticula have been reported. They are of special interest to the clinician in that they must be excluded in the diagnosis of esophageal dilatation.

The symptoms of pharyngeal diverticula are similar to those of esophageal diverticula. Dysphagia is less troublesome, and obstruction is rarely sufficient to cause inanition. Cough and dyspnea from the escape of the contents of the sac, or from pressure upon the recurrent laryngeal nerve are the most characteristic symptoms.

The symptoms of diverticula of the esophagus are in the beginning those of gradually increasing stenosis. At first the patient

complains of a sense of obstruction in swallowing; later, of the regurgitation of small amounts of food at variable periods after eating. As the sac increases in size the symptoms of stenosis become more marked. The lumen of the esophagus is occluded by pressure of the distended sac upon its lateral wall. Further obstruction to the passage of food is caused by a change in the axis of the esophagus. The weight of the food and intra-esophageal pressure elongate the neck of the diverticulum, which comes to lie in the same axis as the upper portion of the esophagus. The opening into the distal portion of the esophagus becomes a slit on the anterior wall at the juncture of the neck of the diverticulum and the proximal portion of the esophagus. As the stenosis becomes more marked, inanition becomes extreme and, as a rule, results in the death of the patient. In the large diverticula much mucus is ejected with the food, and occasionally food taken several days previously may be regurgitated from the sac while that taken in the interval is not returned. Pain after eating is a frequent symptom, usually relieved by the ejection of the contents of the sac. In the pharyngo-esophageal diverticula, the sac, as a rule, comes to lie largely on the left side of the esophagus, and when distended is a visible mass much resembling an enlarged left lobe of the thyroid. This prominence is rarely more marked on the right side. The tumor may be made to disappear by pressure upon the sac, forcing the food into the mouth. Patients almost always complain of an irritable cough. The clinical history and the subjective symptoms are usually sufficient to establish the diagnosis of pharyngo-esophageal diverticulum.

The subjective complaints in deep-seated diverticula and cardio-spastic dilatation of the esophagus are very similar, and may, in some cases, be identical. It is the necessity of excluding deep diverticula in the diagnosis of esophageal dilatation that makes the methods of their recognition of most importance. In diverticula of the upper portion of the esophagus, a sound, as a rule, encounters obstruction sufficiently high to at once exclude diffuse dilatation. The fundus of a deep-seated diverticulum rests on or near the diaphragm, and a sound is obstructed at the same

distance from the teeth as in diffuse dilatation. In either condition the sound, if repeatedly advanced and withdrawn, or inserted on different occasions, may at one time meet obstruction at the diaphragm level, at another time enter the stomach without giving any aid in the differential diagnosis, or, as is more often the case, in diverticula, the sound cannot be made to enter the stomach. This may also occur in diffuse dilatation (10 out of 50 cases in my series).

Of the methods of objective examination which may be looked upon as of importance in making the differential diagnosis, the following will be considered:

1. The skiagraph.
2. Strauss' volume-measure.
3. Rumpel's double sound and its modifications.
4. My own methods of sounding.
5. The esophagoscope.

Most authors make light of the value of skiagraphs, but in our cases of dilatation and diverticula, the position of the shadows and their shapes and relations to the surrounding parts are such that it would be almost impossible to mistake them.

An exact determination of the size of a dilatation is made possible by a method of measuring its volume described by Strauss. For this purpose Strauss employs a stomach-tube at the lower end of which a rubber bag is attached. This is introduced into the lower portion of the esophagus and distended with air, and the amount of air used in its distention is measured. For the differential diagnosis, Strauss now passes the bag into the stomach and inflates again, determining at once that the cavity in which the balloon had been inflated has an opening below communicating with the stomach. As a means of differential diagnosis there are two objections to this method as Strauss uses it: first, the difficulty which is often encountered in introducing the sac into the stomach; second, a sufficient difference in volume will not be noted between small dilatations and the normal esophagus to make the conclusions positive.

Of the other differential diagnosis means, the manifold fenes-

trated sound of Rumpel has, up to date, been the instrument most frequently employed. All sound experiments are based upon the idea that the liquid contained in a dilatation flows off as soon as the passage through the cardiac opening is made free by such a sound. The diverticulum, however, always remains filled, no matter which position the sound assumes. In Rumpel's experiment a multiple fenestrated sound is so introduced that one window opens into the stomach while the fenestrated portion is lying in the esophagus above the cardiac opening. Now a definite quantity of water is introduced into the sac by a common stomach-tube. If a dilatation is present, one cannot siphon water out of the esophagus, since the liquid has flown off into the stomach through the supracardial opening of the sound. If, however, a diverticulum is present, the total amount of liquid can be siphoned, since the latter is accumulated in the diverticulum. Numerous modifications of this method have been proposed, but all are fundamentally the same. All are dependent upon being able to introduce the sound into the stomach. This is possible in some, but by no means in all, cases.

In a paper read before this Association in 1906, I first called attention to the importance of using a silk thread as a guide in esophageal work. The idea of using the thread as a guide in dilating esophageal strictures was, I think, original with Mixter, but had not been employed for other purposes. The patient slowly swallows six yards of silk thread. This passes down through a sufficient number of coils of intestine to prevent its withdrawal on being pulled taut. It is advisable to have the patient swallow three yards in the afternoon and the remaining three yards on the following morning. In this manner the first portion forms a snarl in the esophagus or stomach which passes out into the intestine during the night, the remaining portion passing without snarling. The olives are drilled for threading from the tip to one side of the base. A whalebone staff and olive are used for sounding and for passing the fenestrated tube of Rumpel, Strauss' volume-measure, etc. As the neck of a diverticulum almost invariably lies in an axis with the upper portion of

the esophagus, the sound will enter the diverticulum when the thread is loose. When the thread is drawn taut, the sound readily enters the stomach. By first introducing the sound into the diverticulum until it is obstructed and then drawing the thread taut, the sound will be lifted out of the esophagus sufficiently far to bring the olive to a level with the opening into the distal portion of the esophagus. Until this point is reached the sound cannot again be advanced without relaxing the thread. With the olive at the level of the opening into the lower portion of the esophagus, and the thread drawn taut, the sound may now be advanced into the stomach. This method of procedure is sufficient to demonstrate, by positive means, the existence of a diverticulum, and to locate its point of origin. Rumpel's test, or any of its modifications, may be carried out in this same manner with the added definite knowledge of the location of the point of the tube, and a certainty that it will enter the stomach.

Strauss' volume-measure does not enable us to determine the diameter of the esophagus, but, as its name indicates, is an accurate means of determining the volume of a dilated esophagus. In some cases of periodic cardiospasm, with beginning dilatation of the esophagus, it has been of much aid to determine the diameter of the esophagus above the cardia by means of a sound which I first presented to this society two years ago. This sound is constructed the same as Russell's bag, used for dilating the cardia. A rubber-dam balloon is attached to the lower end of a stomach-tube in such a manner that the tube is closed, and holes are punched in the tube so that its caliber communicates with the interior of the balloon. A spherical or oval silk bag 22 mm. in diameter is drawn over the balloon and fastened to the tube. This is introduced into the stomach with a whalebone staff distended with water under sufficient pressure to make the stylet, tube, and balloon form a solid sound. The sound is drawn up to locate the cardia, collapsed, drawn into the esophagus and distended. If, under distention, the sound can be moved freely up and down, it is withdrawn and the silk bag replaced by a larger one. In this way, by using a series of sounds of increasing size, the diameter

of the esophagus at any point, and an approximate idea of the shape and size of an existing dilatation, may be obtained. The demonstration of a sac by this method is also proof that the sac is a dilatation and not a diverticulum, provided the sound is first introduced sufficiently far to give assurance that it has entered the stomach.

The esophagoscope has proved of great value in the study of primary and secondary cardiospastic dilatation of the esophagus. We have made a practice of making esophagosopic examinations in the cases of diverticula, but cannot say that it has added much to the information otherwise obtained. In the study of cardiospastic dilatation, the esophagosopic examination should never be omitted if the condition of the patient will permit of it.

The six cases of esophageal diverticula which have come under my observation I have reported in this paper. Five of the cases belonging to the pharyngo-esophageal group have been operated upon by Dr. Charles H. Mayo.

A report of the cases follows:

CASE 1.—Male, single, thirty-three years of age; previous history, negative, except for pneumonia five years ago. In January, 1902, he first noticed a sense of obstruction to the passage of food, which he locates beneath the lower end of the sternum. A few months later small amounts of food were occasionally regurgitated either during or soon after a meal. Since the end of the second year, there has not been much increase in the severity of the complaint. Obstruction to the passage of an olive is encountered 20 cm. from the incisor teeth. Slight bulging is noticeable a little to the left of the median line, midway between the cricoid cartilage and the upper border of the sternum. A radiograph was made after giving the patient two ounces of subnitrate of bismuth in mucilage of acacia. In the radiograph a shadow of the bismuth shows a spherical sac one inch in diameter, in the median line and about midway between the cricoid cartilage and the sternum.

Diagnosis: Pharyngo-esophageal diverticulum.

In this case an operation was advised, but the patient refused it.

CASE 2.—Male, married, attorney; has complained of dysphagia of increasing severity for twelve years. The food comes up soon after eating, occasionally a half ounce at a time. Coughing spells cause the regurgitation of food and occasionally the vomiting

of sour food. His general health is not impaired. The patient calls attention to the presence of a bulging in the neck, above the left sternoclavicular articulation, which is increased in prominence by taking a drink of water. A portion of the water is ejected into the mouth by sudden pressure upon this prominence. Sounds meet obstruction 19 cm. from the incisor teeth. A bent sound can be made to pass the obstruction with a little manipulation. The radiograph shows a pear-shaped shadow, 13 by 14 cm. in diameter, two-thirds of which is to the left of the median line. The lower border of the shadow is on a level with the upper border of the sternum.

Diagnosis: Pharyngo-esophageal diverticulum.

This patient was to return for operation, but failed to do so.

CASE 3.—Male, fifty-six years of age; has had slight dysphagia and an irritable cough for eighteen months, and the regurgitation of food and mucus for the past fourteen months. The interference with the taking of food has caused the loss of ten pounds in weight. A prominence is visible above the sternal end of the left clavicle. This is increased in size by drinking water, and pressure upon the sac will cause the ejection of water into the mouth. Obstruction to the passage of a sound is met 23 cm. from the teeth. A radiograph shows a shadow the shape and size of an egg, the lower border of which is one-half inch below the upper margin of the sternum. Operation, April 8, 1908.

CASE 4.—Male, single, is forty-five years of age; gives a history of five years of gradually increasing dysphagia. The complaint was periodic during the first year. During the last four months the act of swallowing has been accompanied by pain in the upper portion of the esophagus. The first few mouthfuls of food seemed to go down all right; later there is a sense of obstruction and the remaining portion of the meal is taken with difficulty. Much of it is immediately regurgitated. Portions of the previous day's food are frequently regurgitated. If he takes food later than 3 P. M., an irritable cough prevents sleep. A radiograph demonstrates a spherical sac $1\frac{1}{2}$ inches in diameter, the greater portion of which is on the left of the median line of the neck. The upper portion of the sac is on a line with the cricoid cartilage. Obstruction to the passage of a sound is encountered 20 cm. from the teeth. A sound with a Mercier tip can be passed on into the stomach.

Diagnosis: Pharyngo-esophageal diverticulum. Operation, June 9, 1908.

CASE 5.—Male, traveling salesman, married, is sixty years of age. For two years food has invariably lodged in the throat while eating and comes up at irregular periods after meals. He loses much sleep because of coughing brought on by the regurgitation of small particles of food. A radiograph shows a sac 3 cm. in diameter in the median line, just below the cricoid cartilage. Sounds invariably passed without encountering any obstruction. An esophagoscopic examination failed to reveal any opening into the sac. Operation, June 8, 1908.

CASES 3, 4, and 5 were operated upon by Dr. C. H. Mayo. In each case the sac was excised, the neck of the sac inverted, and the wound closed without drainage. Infection did not take place in any of the wounds. In each case all evidence of dysphagia disappeared within two weeks after the operation.

CASE 6.—M. J. H., attorney, married, fifty-five years of age; family history, negative. He was not a very strong boy, but became so while in college, and from then on has been a man of unusual good health, with the exception of pneumonia three and one-half years ago. Eleven years ago he first noticed the occasional regurgitation of small amounts of food soon after eating. Gradually the dysphagia became more marked. Within the last three years the dysphagia has been extreme. He has lost from 90 to 130 pounds. During the past year a large part of his time has been consumed in ingesting sufficient food to keep him alive. For ninety days he has been confined to bed by inanition. A general examination is negative except for emaciation. The urine contains a trace of albumin and a few hyaline casts. Just above the sternal end of the left clavicle there is an ill defined fullness much resembling a vascular goiter. Upon attempting to swallow more than four ounces of water, it is regurgitated through the nose and mouth. Pressure upon the prominence above the clavicle forces water and food remnants into the mouth. At every attempt to pass a sound, it is arrested 25 cm. from the teeth. The skiagraph clearly defines the shape and position of the sac, but not the point at which it communicates with the esophagus. The esophagoscope is easily introduced, and a good view of the wall of the sac obtained, but not of the opening into the lower portion of the esophagus. The patient's condition made the immediate removal of the sac out of the question, and the first indication that of nourishment, by the mouth if possible, if not through a gastrotomy opening. Repeated attempts at passing a sound were all unsuccessful. After several attempts

covering a period of two weeks, a silk thread was passed through into the intestines. A stomach-tube was then easily passed on the thread. During the next three weeks he was fed through the tube twice a day. He gained 15 pounds and was able to take long walks. He was operated upon by Dr. Charles H. Mayo on April 4, 1908. The sac was excised, and the neck of the sac was sutured to the external wound. The opening into the sac was not invaginated and closed because of the man's poor vitality, and the fear of infecting the anterior mediastinum. During the first few weeks there was some annoyance from the escape of food through the sinus, which completely closed at the end of three months.

CARDIOSPASM, WITH REPORT OF CASES *

By H. S. PLUMMER

While the purpose of this paper is to report the following cases of cardiospasm with special reference to the treatment, so little attention has been paid the subject by American clinicians that a brief general consideration seems desirable.

CASES 1, 2, 3, AND 4.—A number of years ago three cases were operated upon at St. Mary's Hospital for stenosis of the esophagus. The cause of the stenosis was unrecognized at the time, but in each instance the condition of the patient warranted a gastrostomy. After the operation, periods of feeding by the mouth alternated with periods of introducing food through the gastrostomy opening. As would be expected, the lower opening was resorted to only when the cardia refused to pass food. One case recovered completely. Two were finally lost sight of, but not until sufficient time had passed to exclude malignancy. It is possible that gastrostomy would have given more favorable results had the true nature of the condition been recognized and the esophagus given longer periods of rest. A fourth case was afforded much relief for several years by frequent passage of a large bougie.

Sufficient data were not recorded to make a detailed report of these cases, but an effort is being made to trace them, and they are introduced into this series with the hope that they may be made use of later.

CASE 5.—A. S. T., female, aged fifty-eight, married, never pregnant, was first examined August 6, 1905. She states that she had perfect health until the onset of the present trouble. Periodic dysphagia began four and one-half years ago. During the last three years the trouble has been practically continuous. Painful spasms occur while at the table, though not as frequently as in the first year. The greater part of the food is regurgitated

* Read before the Minnesota State Medical Association, June 19-21, 1906. (Reprinted from "The Journal of the Minnesota State Medical Association and Northwestern Lancet," Oct. 1, 1906.)

soon after eating. Lost 50 pounds in weight. Stomach-tube will enter the stomach only after repeated attempts, but a large sound is easily passed. A radiograph shows a large cylindrical dilatation of the esophagus, three inches in diameter, extending from the diaphragm to the upper border of the sternum.

Diagnosis.—Dilated esophagus, due to cardiospasm.

August 5, 1905, gastrotomy and dilatation of the cardia (Mikulicz method) was done by Dr. W. J. Mayo. This gave immediate relief. Four months later the dysphagia returned, but has been less annoying than previous to the operation.

CASE 6.—C. J., male, eighteen years of age; past history, negative except for diseases of childhood. First examined October 24, 1905. Three months ago he was taken with "hiccough" while eating. This came on with every meal for two weeks, then began regurgitation of food two or three seconds after swallowed, and, within a few weeks, to the immediate regurgitation was added so-called vomiting from one to four hours after eating. Three to six ounces of food mixed with mucus is frequently ejected at one time. It is never sour. There are occasional periods of a few days when he is entirely free from the trouble. He has lost 24 pounds in the last six weeks, is a poorly nourished, sparsely built boy; otherwise the general physical examination shows nothing of special interest. The regurgitated food is slightly alkaline in reaction.

In passing a large sound the position of the cardia can scarcely be detected, while the stomach-tube passes only when stiffened with a wire stylet. Size, position, and contents of stomach found to be normal. Radiographs show a dilated esophagus one and one-half inches in diameter, extending from the diaphragm to the third dorsal vertebra. On January 28 and February 6, 1906, the cardia was dilated with the rubber balloon-dilator. Complete relief followed the first treatment.

CASE 7.—E. E., male, single, aged twenty-nine years; farmer, does not come of a neurotic family. Examined September 28, 1905. Up to three years ago he had perfect health, at this time he began "vomiting." During the first year the periods of dysphagia might be confined to a single meal, the intervals varying from one to fourteen days. The difficulty in keeping food down gradually became more constant, until within the last eighteen months he has not been free from difficulty in swallowing for more than three days at a time. The food either stays down or comes up immediately after swallowed. While eating he waits for each portion to enter the stomach before attempting the next. At any time during, and

always before the meal is completed the opening into the stomach seems to refuse to pass food. He is seldom able to satisfy his appetite, the extreme hunger being the most distressing of his complaints. All statements of the patient indicate that food is never retained in the esophagus. Since the first few months the spasm has been unaccompanied by pain. He has lost weight, falling from 160 to 129 pounds, during the last year. The stomach-tube is arrested 15 inches from the teeth. By passing the tube stiffened with a wire stylet, the contents and size of the stomach are found to be normal. Decided resistance to the passage of a 15 mm. sound is encountered at the cardia, but is overcome by light, steady pressure. Radiographs failed to show anything abnormal. By the methods to be considered under diagnosis, dilatation of the esophagus was excluded. A bulbous sound was passed at frequent intervals during November and December. This gave a little relief, and he gained 10 pounds.

January 8th, 9th, and 16th the cardia was dilated with a balloon-dilator. From the latter date to the present time he has had no dysphagic symptoms. His weight increased from 129 to 161 pounds.

February 17, 1906, he was operated upon for a right inguinal hernia.

CASE 8.—T. W. S., examined January 17, 1906; female, aged twenty-one years; married, and has one child two and one-half years old. Family history, negative. At eleven years of age she had dyspeptic symptoms, *i. e.*, distress and belching after meals. She never considered herself strong, but is not of a decided nervous type. Four months previous to the birth of the child she began to regurgitate food while at the table. The dysphagic spells rapidly increased in frequency, and within a few weeks the complaint differed but little from that made at the present time. The interval between the taking of food and its regurgitation gradually lengthened. As a rule, she eats as freely as though no difficulty existed and the esophageal contents are ejected at intervals throughout the twenty-four hours, without much reference to the time of ingestion. Food entering the nasal passages at night is very annoying. The amount regurgitated at one time varies from a mouthful to half a pint.

The details of the history and findings on examination go to show that the more fluid portions of the food slowly pass the cardiac orifice, the surplus being thrown out. While under observation, pieces of beef were regurgitated seventy-two hours after eating it,

being known that softer food taken in the interval had entered the stomach. This fact is mentioned because it has been made a point as favoring the diagnosis of diverticula as against dilatation. Examination, other than that directed to the trouble under consideration, is negative, except for a small left ovarian cyst. General nutrition is good. At all attempts to pass a soft-rubber stomach-tube it is arrested 15 inches from the teeth. The withdrawn mucus and food contents of the esophagus are alkaline in reaction. Stomach-contents, obtained by passing a soft tube with a wire stylet, show HCl present. Size and position of stomach are normal. In passing a large-sized bulbous sound only normal resistance is encountered at the cardia. On several occasions the sound was passed after thirty-six hours of fasting, and always caused the ejection of considerable food and mucus. The radiograph shows a fusiform dilatation of the esophagus $2\frac{1}{2}$ inches in diameter at its widest portion.

February 28th, March 4th, and March 10th, the cardia was dilated with a rubber balloon. There has been no indication of dysphagia since the last dilatation. A parovarian cyst with twisted pedicle was removed at St. Mary's Hospital on March 17, 1906.

CASE 9.—H. K., examined May 7, 1906; female, aged thirty years; has five brothers and one sister, all in good health. No history of previous illness. First experienced a sensation as of being seized by the throat and choked when at Lenten service in March, 1903; duration, a few moments; repeated at intervals of a few days or weeks during the next eighteen months, at first independent of taking food. Then began the regurgitation of food at progressively longer intervals of time after eating. The food comes up without effort and is not sour. Food frequently runs out of the nose at night. Her weight decreased from 180 to 114 pounds within the last eighteen months. Patient greatly emaciated. Stomach-tube can be passed without encountering resistance at the cardia. Food withdrawn from the esophagus is alkaline in reaction; that from the stomach shows normal acidity. The esophagus is an inch and one-half in diameter from the cardia to the third dorsal vertebra.

The cardia was dilated May 12th and 14th. Since the latter date the patient stated she has been absolutely well and has gained 14 pounds.

CASE 10.—H. P., referred by Dr. B. M. Randall, of Graceville, Minn. Examined June 1st. Male, aged forty years; has had no

serious illness since childhood; five years ago dysphagia began while sick with the whooping-cough. During the first two years the spells were of short duration, were unaccompanied by the regurgitation of food, and occurred only at intervals of several weeks. For the last five years the greater part of each meal has been regurgitated, and for a number of weeks he has been able to get only a small amount of liquid food into the stomach. He is 60 pounds below his normal weight. Loss of weight and strength has been very rapid during the last few weeks.

The cardia was dilated June 2d, and at the meal following the dilatation nothing abnormal could be detected. Since June 2d he has gained 25 pounds.

CASE 11.—Examined June 10, 1906, K. C., male, aged thirty years, farmer. Previous history, negative. Dysphagia began eighteen years ago. Patient is unable to recall many details of the early history, but states that there was a short period during which the food was regurgitated. He then learned to force the food into the stomach by rapidly drinking a glass of water after filling the esophagus with solid food. During the eighteen years all food has been taken in this way. The last year eating has been slow, and he has with difficulty taken sufficient food to satisfy his appetite. Within the last few months he has been losing weight. As shown in a radiograph, the dilated esophagus is shaped much like an Erlenmeyer's flask, the base resting on the diaphragm. Repeated attempts at passing a stomach-tube and the ordinary bulbous sound into the stomach failed. Finally a 15 mm. olive-shaped bulb was drilled from the tip to a point a little to one side of its base with a $\frac{1}{16}$ -inch drill. This was threaded on a silk thread and introduced by the method made use of by Dunham to pass bougies in cases of cicatricial stenosis. With the thread drawn taut, the sound readily entered the cardia and passed with very little pressure, but failed to give any relief to the patient. The following day a balloon-dilator was introduced in a similar way, and the cardia stretched. Since the treatment the patient has been unable to detect any obstruction to the passage of food.

“In 1874 Von Ziemssen and Zenker collected the first series of cases of so-called idiopathic dilatation of the esophagus. They were nearly all based on post-mortem records, little being known of the history of the patients.” The condition was first attributed to cardiospasm by Mikulicz in 1882. In the “Deutsche medicinische

Wochenschrift," for January, 1904, he quotes the following causes from Lichtheim, and admits them as factors: first, primary cardiospasm (Mikulicz and Meltzer); second, primary atony of the musculature of the esophagus (Rosenheim); third, simultaneous presence of cardiospasm and paralysis of the circular fibers of the esophagus brought about by paralysis of the vagus (Kraus); fourth, congenital disposition (Fleiner); fifth, primary esophagitis (Martin).

Whether the cardiospasm precedes or follows the dilatation of the esophagus is of considerable interest in the prognosis of the cases treated by forcible dilatation. If atony be the primary condition, it would seem that there may be little hope for the permanency of the good results following the procedure. The sequence of the symptoms in the cases here reported—*i. e.*, the early spasmodic pain, later regurgitation, and, still later, retention of food for progressively longer periods—is that which we would expect in stenosis of the cardia followed by increasing dilatation of the esophagus. That cardiospasm precedes the dilatation is still further borne out by Case 5, in which dilatation had not occurred, and the history corresponds in the essential details with the history of the other cases previous to the stage of retaining food in the esophagus. This is the only case in which spasm of the cardia could be unmistakably demonstrated by sounding.

It does not seem at all improbable that atony and dilatation may occur as a primary condition in some cases. Once established, the dilated esophagus is, perhaps, equally responsible with the cardiospasm in continuing the train of symptoms.

Under normal conditions the solid food is pushed forward by the peristaltic contraction of the muscles of the esophagus, but after dilatation of the esophagus takes place the food is forced into the stomach only by its own weight. Case 11 overcame the resistance at the cardia by putting the food into the dilated portion of the esophagus under pressure. This the patient accomplished by filling the sac, and then swallowing water rapidly. There is a decided periodicity throughout the history in nearly all the cases. Up to the time when dilatation takes place, the intervals between

the dysphagic spells are not marked by any complaint whatever, but with dilatation the symptoms become almost continuous, and during the periods of exacerbation the occlusion at the cardiac opening may be almost complete. The dilated esophagus is never completely emptied and may contain several ounces when the patient states that food is going through all right. In Case 8 a 20 mm. sound would almost drop through the cardia of its own weight at a time when the esophagus held half a pint of soft food after thirty-six hours of fasting. From these observations it seems probable that the periods of exacerbation occurring after dilatation has taken place correspond to the periods of dysphagia previous to the dilatation, and that the detention of food in the esophagus during periods of comparatively little trouble is due to lack of force to expel its contents through the cardia contracted little, if any, more than in its normal condition.

There is nothing in the history of these cases to suggest the presence of esophagitis previous to the spasm of the cardia. Esophagitis secondary to the dilatation is a result to be expected from the retention of food.

The apparent rarity of this disease, as indicated by the few cases reported in the literature of this country, must be due to the failure to recognize a symptom-complex which is almost pathognomonic. There are many reasons for this; perhaps the most important is the paucity of literature, as most of our text-books fail to mention the condition. The complaint as made by the patient is much like that made by some cases of nervous vomiting, and if stenosis is expected, this is apt to be dissipated by the failure to meet resistance or gain relief from the passage of large sounds.

As a rule, the first attack of cardiospasm occurs suddenly and unexpectedly. A spasmodic, choking sensation is felt at some point in the esophagus, usually at the cardia, and radiates to the neck or back. As in Case 9, this may occur at intervals over a long period, independent of taking food or liquid. Early in the history of regurgitation the food is returned to the mouth immediately after being swallowed, but as the esophagus becomes dilated

the food is retained for longer periods. The esophagus is rarely found empty, even after hours of fasting.

That the food does not seem to enter the stomach, that there is a sense of weight or discomfort in the chest, and that the ejected matter is not sour, are statements common to all the patients. Since, under normal conditions, the force of gravity is sufficient to carry liquids from the mouth to the stomach, while solid foods are carried along by the peristaltic contraction of the esophagus, liquids are more often regurgitated than solids before dilatation takes place. After the esophagus becomes dilated, soft food more readily passes the cardia. As in Case 11, the patient may learn to use the upper portion of the esophagus to compress the contents of the sac and force the food into the stomach. Cases 6, 8, 9, and 10 complained much of the regurgitation of food into the nasal passage during sleep.

The failure to pass a stomach-tube, when a large sound readily enters the stomach, should at once suggest the possibility of cardiospasm. In the diagnosis, cardiospasm is to be differentiated from organic strictures, carcinoma, etc.; from obstruction due to external pressure; from diverticula of the esophagus; and from certain conditions causing the regurgitation of food from the stomach. The unyielding character of the obstruction met with in passing a large sound in organic stricture at once shuts out cardiospasm. As illustrated by Cases 8 and 10, one must be assured that the sound has entered the cardiac opening, and not impinged upon the pouched wall of the esophagus.

It may be possible to exclude malignancy, early in the history of dysphagia, in which case it is advisable to avoid undue instrumentation and await the further progress of the disease.

The diagnosis of tumors, aneurisms, etc., causing dysphagia by pressure upon the esophagus, depends largely upon direct evidence of the existence of these diseases. If any doubt exists as to whether the food is being returned from the stomach or the esophagus, a stomach-tube with a wire stylet is introduced, and the esophageal contents withdrawn. The tube is now passed into the stomach, the stomach contents obtained, and a differential diagnosis made on an analysis of the two portions of food.

Passage of a soft stomach-tube was impossible in all of the cases here reported, with the two exceptions noted, but no difficulty was experienced when the tube was stiffened with a steel wire, except in Cases 8 and 10. In Case 8, the tube was passed by giving it the bend of Mercier's sound, and in Case 10 by the method described in the history.

Having excluded organic stricture, cause for external pressure, and determined that the regurgitated food does not enter the stomach, the diagnosis lies between diverticula and dilatation of the esophagus. In spasm of the cardia without dilatation, the history of the case and absence of obstruction to the passage of a large sound are usually sufficient to establish a diagnosis. It is easily confirmed by the relief obtained from dilating the cardia. The history and findings in diverticula and in dilatation of the esophagus with spasm of the cardia may be almost identical, the differential diagnosis resting upon direct proof of the existence of either one or the other. As only those cases of diverticula originating below the middle third of the esophagus are apt to cause confusion, diverticula located higher up are not here considered.

Radiographs were made in Cases 6, 7, 8, 9, 10, and 11 immediately after giving two ounces of bismuth mixed with starchy food. The dilated esophagus is clearly shown in all but Case 7, and the positions of the shadows and their relations to the surrounding parts are such that it would be almost impossible to mistake them for diverticula.

If any doubt exists, the method to which I resorted in Case 7 to demonstrate the absence of dilatation may be used. A rubber balloon is introduced, distended, and drawn against the cardia to prove that it has entered the stomach. It is now drawn into the stomach, again distended with the bismuth mixture under sufficient pressure to overcome the elasticity of the rubber, and then radiographed. The relative position of the anode, plate, and balloon being known, the exact diameter of the esophagus can be ascertained. The existence of a sac being assured, the determination that the esophagus is of normal size is sufficient evidence that the sac is a diverticulum.

The difficulty in keeping some nervous patients quiet for a sufficient time to obtain a radiograph led me to devise a sound which, I think, gives more positive evidence than any of the methods heretofore used. A rubber-dam balloon is attached to the lower end of a stomach-tube in such a manner that the tube just passes through the balloon. The end of the tube is closed, and holes are punched in the tube so that its caliber communicates with the interior of the balloon. An oval silk bag one inch in diameter is drawn over the balloon and fastened to the tube. This is introduced into the stomach with a steel stylet and distended with water under sufficient pressure to make the stylet, tube, and balloon form a solid sound. The sound is drawn up to locate the cardia, collapsed, drawn into the esophagus, and distended. If, under distention, the sound can be moved freely up and down, it is withdrawn and the silk-bag replaced by a larger one. In this way, by using a series of sounds of increasing size, the diameter of the esophagus, at any point, and the approximate idea of the shape of an existing dilatation, may be obtained.

Until recently the treatment of cardiospasm has consisted of such ineffectual measures as attention to the patient's general condition; fluid, non-irritating diet; effervescent powders; bromids; the frequent passage of large sounds; and, as a last resort, gastrostomy. Mikulicz, in the "*Deutsche medicinische Wochenschrift*," of January and February, 1904, reported that he operated upon four cases with apparently perfect success. A gastrotomy was done, and under control of two fingers a long, curved forceps, the blades covered with rubber, was worked into the cardia. The forceps was gradually opened until the maximum distance between the blades reached 6 cm., and the cardia then restretched to its utmost. In the "*Annals of Surgery*," of February, 1906, Erdmann reports one case entirely cured by this method after an interval of twenty months. Case 8, here reported, was completely relieved for four months.

The seriousness of the condition warrants this major operation only provided equally good results cannot be obtained by simpler means of forcible dilatation. Russell* reports six cases treated by

* "*Brit. Med. Jour.*," June 4, 1898.

dilating the cardia with a silk-covered rubber balloon. Four cases were completely cured, one was much improved, and one was not improved. Sippy, at the recent meeting of the American Medical Association, reported a number of cases successfully treated in this way. The dilator, as used on the cases here reported, is made by cementing a rubber-dam balloon to one end of a piece of non-elastic rubber tubing in such a manner that the tube just passes through the balloon. The end of the tube is closed with a rubber plug, and a number of holes so punched that its lumen communicates with the interior of the balloon. A sausage-shaped silk bag is drawn over the balloon to preserve its shape under distention. Several sizes, 5 inches in length and varying from $\frac{3}{4}$ to $1\frac{1}{4}$ inches in diameter, are provided. If the dilator is slightly constricted in its middle third, the tendency for it to slip into the stomach or esophagus is lessened. A flattened steel wire is used as an introducer. Provision for connecting a tube leading to a water tap or pump is made. A section of this tube is doubled. One passage is narrowed by inserting a capillary glass tube, and the other section is provided with a stop-cock. An altitude gage is also connected by means of a T joint. Having previously determined the position of the cardia, the dilator is introduced sufficiently far for the cardia to engage the balloon at its middle third, and the water turned on at the tap until the gage indicates the pressure of one or two feet. The stop-cock is now closed, and the pressure slowly raised to the required point by forcing the water through the capillary tube. The force to be used is determined by the tolerance of the patient and the results obtained from former attempts. The pressure used ranged from 5 to 25 feet, great variation being shown in the ease with which the cardia dilates. In Case 6 the cardia contracted sufficiently to cause obstruction within a few days after each dilatation, until a pressure of approximately 15 pounds was reached. The reason for the failure to obtain satisfactory results by those who have used the mouth to expand the dilator is at once apparent. Danger of tearing the esophagus is to be avoided by stretching slowly and having the dilating force under such control that it may be instantly released if severe pain indicates any giving way of the tissues of the cardia.

Sudden expansion of the dilator, should a tear start, is guarded against by constructing an instrument of rigid tubing, filling the dilator with a non-compressible medium, and having the water-supply almost shut off by the capillary tube. If a compressible medium like air is used, dilatation of the cardia from a small caliber to the full size of the dilator can take place without materially lowering the pressure, and therefore, should the tissues begin to give way, a large rent in the esophagus might suddenly occur. To further provide against accidents, dilators of increasing size should be employed, but this is no safeguard unless sufficient pressure is used to give assurance that each successive size is extended to its full diameter. Two or three dilatations have been sufficient, as judged by the results obtained, to paralyze the circular musculature of the cardia completely. Recurrence of the dysphagia will depend largely upon the ability of the dilated esophagus to regain its normal size and tone. Relapses are to be expected in some of the cases. The size of the dilated esophagus will be determined from time to time in the cases which can be kept under observation, and the ultimate results reported.

CARDIOSPASM, WITH A REPORT OF FORTY CASES *

By H. S. PLUMMER

The first series of cases of so-called idiopathic dilatation of the esophagus was collected by von Ziemssen and Zenker in 1878. The report was based mostly on postmortem findings, little being known of the history of the cases. For our knowledge of the symptomatology of the disease we are indebted to the writings of Lichenstein, von Strümpell, Meltzer, Rumpel, Kraus, Rosenheim, Fleiner, Ewald, Netter, Kelling, Einhorn, Martin, Oppler, Gottstein, Dauber, Zausch, Strauss, Lossen, Sippy, and others.

In 1904 Mikulicz estimated that 100 cases could be collected from literature. Since that time a number of cases have been reported, notably in German literature, and by Sippy, Lerche, and Erdmann in this country. Gottstein, in Keen's "Surgery," states that 140 cases have so far been reported, and himself adds 25 more. This paper is based on 40 cases which have come under my observation. Eleven cases of this series were reported in a paper read before the Minnesota State Medical Society in June, 1906.

The disease has been attributed to the following causes: first, primary cardiospasm (Meltzer); second, primary atony of the musculature of the esophagus (Rosenheim); third, simultaneous presence of cardiospasm and paralysis of the circular fibers of the esophagus, brought about by paralysis of the vagus (Kraus); fourth, congenital disposition (Fleiner, Zenker, Luschka, and Sievers); fifth, primary esophagitis (Martin), and, sixth, kinking at the hiatus esophagei.

* "Northwestern Lancet," September, 1906. (Reprinted from "The Journal of the American Medical Association," August 15, 1908, vol. li, pp. 549-554.)

The unsatisfactory condition of our knowledge of the etiology of this disease is indicated by the variety of the titles under which the cases have been reported—idiopathic, fusiform, diffuse dilatation; dilatation without anatomic stenosis, etc.

Gottstein classifies motor disturbances of the esophagus as follows:

1. Hyperkinetic, in which spastic contractions of the muscle exceed the physiologic normal.
2. Hypokinetic, in which there is an impairment of the normal muscular tone.

While it is probable that primary atony of the esophageal muscle rarely occurs, I doubt very much its being a frequent factor in the cases which have been reported under the headings, idiopathic dilatation of the esophagus, cardiospasm, etc. In the study of a considerable number of cases the almost invariable history of spasm at the onset, followed at a later period by the evidence of dilatation—that is, retention of food in the esophagus—is most convincing evidence that the spasm precedes the dilatation and that primary atony is relatively a rare condition. This conclusion is further borne out by the evidence of early muscular hypertrophy in nearly all cases which have come to postmortem; by the frequent observation of severe cardiospasm unaccompanied by dilatation of the esophagus, and by the good results which have followed forcible dilatation. The occasional case in which spasm cannot be demonstrated does not exclude its being the primary factor. The spasm is in many cases periodic, and after dilatation takes place, little if any more than the normal tone of the cardiac muscle is required to produce evidence of stenosis. Rosenheim, in support of the theory of primary atony, reports cases in which the food passed slowly through the esophagus, causing discomfort or pain, but he fails to show that these cases ever develop spasm at the cardia or dilatation of the esophagus.

The history, as given in Cases 11 and 24, suggests the possibility of dilatation almost from the onset. These histories date back eighteen and twenty-six years, and it is very probable that the more striking symptoms that came on with the dilatation overshadowed

the early symptoms of spasm in the patient's memory. Severe spasm was present at the time these cases came under observation. Atony of the musculature of the entire gastro-intestinal tract, without obstruction, is frequently observed, but it is almost invariably associated with other neurotic manifestations. There is no reason why spasm should exist in primary atony unless we accept Kraus' theory of a simultaneous atony and spasm from degenerative changes in the vagus. His theory rests on the finding of degenerated fibers in the vagus in one case which came to postmortem. His observations have not been confirmed.

The theory of congenital disposition is interesting but not susceptible of demonstration. That anlage may be a factor in some instances is suggested by the few rare cases reported as occurring congenitally or in early childhood (Luschka, Fleiner, Zenker, Gottstein). In six cases of this series sufficient angulation at the cardia was present to prevent the passage of a sound by the usual method. Whether this exaggeration of the normal obliquity of the insertion of the esophagus through the diaphragm is the cause of the spasm, or is a result, I am unable to state.

The cause of the spasm is largely speculative. A few cases have been reported associated with gross lesions of the esophagus, such as ulcers, fissures and small carcinoma in the cardia, carcinoma of the stomach, etc. We have seen three cases of carcinoma complicated by cardiospasm, and one case of hour-glass stomach due to syphilis with secondary cardiospasm. Esophagitis and ulcer of the esophageal wall not in close proximity to the cardia are to be looked on as secondary to cardiospasm and dilatation, not as primary factors. In the majority of cases, however, no such possible etiologic factors are to be found. Cardiospasm is not often present in inflammatory conditions of the esophagus which come under observation. Evidence of esophagitis previous to the onset of the cardiospasm could not be elicited from any of the cases. With three exceptions, none of the forty cases reported had neurasthenic symptoms. The age and sex of the patients may be seen by referring to the accompanying table. The average age at onset

is twenty-nine years; twenty-two patients are females, eighteen males.

Deglutition is a complicated, reflex act in which many muscles coöperate. Without entering into a discussion of the exact part played by each, it may be stated that food is carried from the mouth into the esophagus by the omohyoids, hyoglossi, pharyngeal and associated muscles. In the upper portion of the tube the bolus is rapidly carried down by the cross-striated muscles of its walls; in the lower portion it is moved more slowly by the peristalsis of the smooth muscle-fibers. The cardia is supplied through the vagus with both dilating and contracting fibers, presided over and controlled by the medulla (von Operchowski). The normal action of this mechanism is but imperfectly understood, and even less is known of its disturbances in cardiospasm. The cardia is normally closed by contraction of its sphincter muscle, and is opened by its dilator nerves, and the bolus of food is pushed into the stomach by the peristalsis of the esophagus. Authors differ as to the way in which liquid food is carried along the esophagus. According to Cannon, Meltzer, and Moser, liquids are carried deep into the esophagus or to the cardia by the forcible contraction of the omohyoids and associated muscles. Schreiber says that liquids are moved down the esophagus by peristalsis. Be this as it may, the esophagus is unable to force liquids and solids past an obstructed cardia with equal facility. After dilatation takes place the bolus of solid food is carried forward in a normal manner as far as the upper end of the dilatation. At this point the peristaltic contraction ring ceases to exert any direct force on the bolus, but sweeps around it.

Food is propelled from the dilated esophagus into the stomach by two forces—gravity and increased esophageal pressure. The force exerted by gravity equals the height of the column of liquid food in the esophagus. The intraesophageal pressure is raised above the normal by those forces which raise intrathoracic pressure, and by crowding more food into the partially filled dilatation. At each act of deglutition sufficient food is ejected into the stomach to lower the intraesophageal pressure to a point where it is no longer sufficient to overcome the resistance offered by the spastic cardia.

Little, if any, more than the normal cardiac tone is required to cause the retention of food in the esophagus. These points are well illustrated by Cases 35 and 37. Each patient had learned to take sufficient food to maintain a fair state of nutrition, by first swallowing solid food to the point where he was conscious that more would be regurgitated; then at the end of inspiration several swallows of fluid were rapidly and forcibly thrown into the esophagus, thus using the pharynx and upper portion of the esophagus much like the pump of a hydraulic press. The patient in Case 37 has acquired to a nicety the ability to practise this act. She stated that very rarely, if ever, during the last few years of her trouble had any food been regurgitated. During the period in which she was under examination, previous to dilating the cardia, from 4 to 12 ounces of food could be withdrawn from the dilated esophagus five hours after eating.

In the development of cardiospasm three stages, more or less clearly defined, may be recognized in the clinical histories.

1. In this stage the peristaltic contraction of the esophagus is sufficient to force the food through the spastic cardia. This is characterized clinically by the complaint of discomfort, pain, choking sensation, etc.

2. The peristaltic force of the esophageal muscle is no longer able to overcome the resistance of the contracted cardia, and the food is immediately regurgitated. This may result from an actual or relative increase in the obstruction at the cardia; that is, the spasm may become accentuated or the esophageal muscle may tire under the unusual load. In some cases the spasm is sufficiently severe from the onset to cause the immediate regurgitation of food. As a rule, the spasm is, during the early part of the history, periodic; but as the condition develops mild spasm becomes more continuous or constant. Marked exacerbations in the spasm characterize the entire course of the disease. The increased work of forcing the food past the contracted cardia results in an early hypertrophy of the esophageal musculature. As the spasm increases in severity the esophagus becomes less and less able to overcome the obstruction, and atony and dilatation result.

3. Once the esophagus begins to give way the dilatation is rapid. This stage is characterized clinically by the retention of food in the esophagus and its regurgitation at irregular intervals after ingestion. If the spasm is mild for a sufficient length of time from the onset, the hypertrophy may become extreme and dilatation not take place or be delayed for years. The hypertrophy, after becoming well developed, may overcome a most marked resistance at the cardia. Relatively frequent severe spasm at the onset may lead to early dilatation before hypertrophy of the esophagus has time to develop. An impaired tone in the esophageal muscle at the onset of the trouble may also have something to do with the rapid early dilatation that takes place in some cases.

The symptom-complex in cardiospasm is, as a rule, almost pathognomonic. It may be divided into the three stages noted in considering its development: first, cardiospasm without food regurgitation; second, cardiospasm with immediate food regurgitation; third, cardiospasm with dilated esophagus, the retention of food in the dilated portion and its regurgitation at irregular intervals after taking. In the majority of cases the first attack of spasm occurs suddenly and unexpectedly when the patient is at the table. A spasmodic, choking sensation is felt at some point in the course of the esophagus, generally located at the cardia and radiating to the back or neck. It is rarely described as a pain. Some patients locate the discomfort entirely in the epigastrium, left hypochondrium, or in the upper portion of the esophagus. It may occur for months independent of the taking of food. In Case 40 many physicians had, during the course of twenty years, agreed with the patient in attributing the obstruction to an adenoma of the thyroid. The spasm is often described as a slight delay in the passage of food or the food "seems to stick beneath the lower sternum."

In the second stage the food is, after swallowing, immediately regurgitated. During the early portion of the history the attacks occur periodically, or mild spasm is continuous, with periods of marked exacerbation which are characteristic of the entire course of the disease. The patient in Case 9, in which the esophagus was not dilated, had periods of three to seven days in which all solid

food was immediately regurgitated, alternating with periods of days or weeks of absolute freedom from dysphagia. In Cases 6,



Fig. 4.—Whalebone staff, with olive drilled for silk thread.



Fig. 5.—Whalebone staff, spiral tip and olive.



Fig. 6.—Dilator.

27, and 28 the first attack of spasm was severe enough to cause immediate food regurgitation.

After dilatation of the esophagus takes place the spasmodic, choking sensation may be absent. The first portion of each meal

is retained. After filling the sac, further food is regurgitated or forces the preceding portion into the stomach. Of the contents of the esophagus at the completion of a meal the more fluid portion may slowly seep through the cardia; the solid food with much mucus is either regurgitated at irregular intervals or remains in the sac until the next meal. Solid food, like meat, may be delayed at

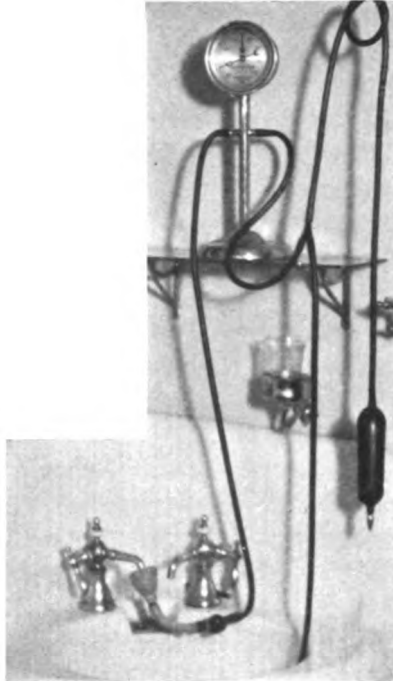


Fig. 7.—Dilator, showing arrangement of tubing.

the cardia for several days, softer food in the meantime passing into the stomach. The sac is never completely emptied, several ounces of solid food often being present in the dilated esophagus when the patient states that it is going through all right. On many occasions I have withdrawn from 2 to 16 ounces of food after twenty-four to thirty-six hours of fasting. That there is a sense of weight or discomfort in the chest, and that the food is not sour, are

statements common to all cases. The vomiting is painless and but rarely accompanied by nausea. Some insist that the food enters the stomach but will not stay. The majority state that it lodges beneath the lower sternum. Ten cases of this series complained of waking at night to find the nasal passages filled with food.

Of this series, seven cases came under observation during the second stage and thirty-three during the third stage. Four cases of secondary cardiospasm are not included. Loss of weight was notable in the majority of the cases. A few maintained a fair degree of nutrition in spite of the dysphagia. Two of the cases in the second stage and ten of the cases in the third stage were markedly emaciated. The patients in Cases 10 and 41 could not walk without assistance, and the patients in Cases 22 and 42 were brought in on cots.

In the diagnosis and study of a case of cardiospasm the following points should be demonstrated:

1. The food is regurgitated from the esophagus and not from the stomach.
2. The existence and character of obstruction at the cardia.
3. The presence or absence of esophageal dilatation and its shape, size, etc.
4. The presence or absence of gross lesions in the esophagus or neighboring organs which might excite the cardiospasm.

In the demonstration of these points the following measures have been resorted to:

1. The various stomach-tube tests, including the methods proposed by Rumpel, Kelling, and Einhorn.
2. Passage of a bulbous sound on a whalebone staff.
3. The passage of the sound which I have devised.
4. Radiographing a bismuth mixture in the dilated esophagus.
5. Determination of the size of the dilatation, by means of a rubber balloon distended within the esophagus.
6. Esophagoscopy examination.

Each case is given a test meal. If sufficient obstruction exists to prevent the food from entering the stomach, it is given with a tube; a second portion of the meal is given in the usual way. At

the end of an hour the tube is again introduced and the stomach contents obtained. The tube is now withdrawn into the esophagus, the contents obtained, and the two portions are analyzed. Free HCl was not found in the esophageal contents from any of the cases. In the analysis of the stomach contents no marked variations from the normal were noted. The average acidity was below normal; a high acid content was present in a few cases. In all except Cases 7, 13, 17, 18, 30, 39, and 43 (second stage) food was present in the esophagus. On many occasions several ounces of food were withdrawn from the sac after twenty-four hours of fasting. In nearly every instance when a tube was passed during a remission in the complaint, and the patient stated that the food was going through all right, small or even large amounts of food were found in the esophagus. The simple introduction of a tube usually causes the regurgitation of non-acid food, which comes up in a manner that leaves little doubt of its source. In eight cases it was possible to pass a tube in the ordinary manner; in sixteen cases, with a wire stylet or a staff and olive; in ten cases by means of a silk thread and a whalebone staff; in six cases by means of a silk thread, staff, and spiral tip referred to later. The more complicated tests of Rumpel, Einhorn, and Kelling were frequently resorted to, but are unnecessary and often unsatisfactory.

The failure to pass a stomach-tube when an olive readily passes the cardia is at once suggestive of cardiospasm. In thirty cases the passage of a 15 mm. olive was possible without encountering any marked obstruction. In ten cases it was impossible to pass the bulb, at least without using greater force than I considered safe. In these cases the sound was passed on a silk thread as a guide. The patient slowly swallows six yards of silk thread. This passes down through a sufficient number of coils of intestine to prevent its withdrawal on being pulled taut. It is advisable to have the patient swallow three yards in the afternoon and the remaining three yards on the following morning. In this manner the first portion forms a snarl in the esophagus or stomach, which passes out into the intestine during the night, the remaining portion passing without snarling. The olives are drilled for threading from the

tip to one side of the base. With five exceptions, no difficulty was experienced in passing a 15 mm. olive when using the silk thread as a guide. As a rule, a slight increase in the resistance was encountered at the cardia, but frequently the olive passed without its detection. Rarely was that slow giving way at the cardia, frequently described by authors, encountered when the sound was passed on the thread. It can at least be stated that marked resistance to the passage of a sound in cardiospasm does not often exist, provided it enters the cardia directly. Obstruction sufficient to prevent the passage of a sound is due to its being caught by contact with the bottom of the sac; and the sense of the slow giving way of the cardia under gentle pressure is due to the resistance encountered in sliding the olive along the flaring wall of the esophagus or the straightening out of some fold just as it is about to enter the cardia. The character of the resistance met at the cardia with the knowledge obtainable only by passing the sound on a thread, that the sound is directly entering the cardiac orifice, is of the utmost importance in the differential diagnosis of organic and spasmodic stricture at the cardia. In six cases, using a whalebone staff 3 mm. in diameter, I found it impossible to pass the sound. The patient in the first case encountered could take sufficient food to make it seem improbable that sufficient narrowing at the cardia could exist, either from cicatricial or spasmodic stricture, to prevent the passage of a 3 mm. olive. Only one conclusion was tenable, namely, that there must be some angulation or tortuosity present. I had the flexible tip shown in Fig. 5 made to screw on to the end of the whalebone staff. It is very flexible, but will not double on itself when subjected to a force that can be safely used in sounding. With this tip the 15 mm. olive readily passed the cardia in the six cases referred to.

Radiographs were made in all except Cases 1, 2, 3, and 4. Exposures were generally made after giving the patient two ounces of bismuth mixed with kumiss, mucilage of acacia, or starchy food. The greatest contrast was obtained by radiographing a rubber-dam balloon, distended with the bismuth mixture, within the dilated esophagus. The dilated esophagus is most clearly shown by placing the tube and plate so that the rays penetrate in an oblique

direction from the right anterior to the left posterior, thus throwing the shadow to the left of the spine on the plate. However, this distorts the shadow more than a picture taken directly antero-posteriorly. The shadows in all except Cases 7, 13, 17, 18, 20, 30, and 43 indicated dilatations which would hold from 6 to 20 ounces, and corresponded in size with the measurements obtained with my sound and by filling with water. In all but three cases the dilated esophagus was clearly shown and the position of the shadows and their shapes and relations to the surrounding parts were such that it would be almost impossible to mistake them. Radiographs showed the dilatation to be spindle-shape in 18 cases, cylindrical in 12 cases, and pyriform in 3 cases.

The dilatation almost uniformly extended as high as the third dorsal vertebra. In Case 5 the shadow extended from the cardia to the upper margin of the sternum and had an almost uniform diameter of $2\frac{1}{4}$ inches.

In Cases 7 to 40 the radiographic findings were confirmed by a method of sounding to which I first resorted in Case 7 to demonstrate the absence of dilatation. This sound is constructed the same as the Russell bag used for dilating the cardia. A rubber-dam balloon is attached to the lower end of a stomach-tube in such a manner that the tube is closed, and holes are punched in the tube so that its caliber communicates with the interior of the balloon. A spherical or oval silk bag 22 mm. in diameter is drawn over the balloon and fastened to the tube. This is introduced into the stomach with a whalebone staff and distended with water under sufficient pressure to make the stylet, tube, and balloon form a solid sound. The sound is drawn up to locate the cardia, collapsed, drawn into the esophagus, and distended. If, under distention, the sound can be moved freely up and down, it is withdrawn and the silk bag replaced by a larger one. In this way, by using a series of sounds of increasing size, the diameter of the esophagus at any point, and an approximate idea of the shape and size of an existing dilatation, may be obtained. The demonstration of a sac by this method is also proof that the sac is a dilatation and not a diverticulum, provided the sound is first introduced sufficiently far to give assurance that it has entered the stomach.

Strauss' method of measuring the capacity of the esophagus is more accurate and should be carried out in all cases for the purpose of determining the fate of the dilated esophagus after the cure of the cardiospasm. A rubber balloon is distended within the esophagus with air, and the amount of air measured as it is introduced.

To complete the diagnosis an esophagoscopic examination should be made. In addition to the catarrhal changes, evidence of muscular hypertrophy, ulcerations, scars, papillary excrescences, etc., may be noted. The cardia appears funnel-shaped or like a roset. Fissures and ulcers at the cardia should be carefully watched for, as they may be looked upon as excitors of the spasm and require either preliminary treatment or additional care when dilating the cardia. The occlusion at the cardia is in many cases sufficient to prevent the passage of the instrument. This is due not so much to the strength of the spasm as to the impossibility of presenting the esophagoscope perpendicularly to the plane of the cardia. This difficulty may be overcome either by an esophagoscopic obturator, or, in some cases, by painting the cardia with a cocain solution.

The obturator is made of steel and tapered so that the flexible tip gradually merges into the rigid tube of the esophagoscope. The olive and cylindric portion of the obturator are drilled so as to permit of passing it on a silk thread. This obturator in many cases very much facilitates the introduction of the instrument at the *in-troitus*.

Until recently the treatment of cardiospasm has consisted in such ineffectual measures as attention to the patient's general condition; fluid, non-irritating diet; effervescent drinks; bromids; the frequent passage of large sounds; and, as a last resort, gastrotomy. In the first four cases of our series gastrotomy was done. Three of the cases were operated on at St. Mary's Hospital for stenosis of the cardia. Its cause was unrecognized at the time, but in each instance the condition of the patient warranted a gastrotomy. After the operation, periods of feeding by the mouth alternated with periods of introducing food through the gastrotomy opening. In one case the patient completely recovered; two were finally lost sight of. Case 4 was afforded much relief for several

years by the frequent passage of a large bougie. These cases are introduced into the series for future reference.

Mikulicz* reported that he had operated in four cases with apparent perfect success. A gastrostomy was done, and under the control of two fingers a long, curved forceps, the blades covered with rubber, was worked into the cardia. The forceps was gradually opened until the maximum distance between the blades reached 6 or 7 cm. Erdmann† reports one case entirely cured by this method, after an interval of twenty months. Case 8 of this series was completely relieved for four months by this operation. This major operation is warranted only provided the condition is serious and that equally good results cannot be obtained by simpler means. Russell‡ was the first to report a sufficient series of cases to demonstrate the efficacy of dilating the cardia with a silk-covered rubber balloon. Four cases were completely cured, one was much improved, and one was not improved. About thirty cases have been reported as cured by this method.

The construction of the dilator as used in the cases here reported is readily seen from Figs. 6 and 7. It is made by cementing a rubber-dam balloon to one end of a piece of non-elastic rubber tubing in such a manner that the tube just passes through the balloon. A number of holes are so punched in the tubing that its lumen connects with the interior of the balloon. A sausage-shaped silk bag is drawn over the balloon to preserve its shape on distention. Several sizes, 10 cm. long and from 20 mm. to 40 mm. in diameter, are provided. A second rubber balloon is drawn over the instrument to facilitate its introduction. If the dilator is slightly constricted in its middle third, the tendency for it to slip into the stomach is lessened. Provision is made for removing the staff to prevent its maceration when not in use. To avoid the annoyance incident to exchanging silk bags, it is well to have several dilators, only one staff being necessary. The metal tip of the staff is threaded for the set of olives used in sounding and for the spiral steel tip previously referred to. The dilator is connected by rubber tubing

* "Deutsch. med. Wochenschr." Jan. and Feb., 1904.

† "Ann. Surg.," February, 1906. ‡ "Brit. Med. Jour.," June 4, 1898.

with a water-tap or pump. Into this tubing two hard-rubber T joints are inserted, one for an altitude gage or manometer, and the other for a piece of tubing to permit draining the instrument without disconnecting at the tap, and for controlling the pressure. The position of the cardia having been previously determined, the dilator is introduced sufficiently far for the cardia to engage the balloon at its middle third. The instrument is firmly held with the right hand, the index-finger resting against the teeth, to prevent the dilator being drawn into the stomach. The tap is now opened enough to fill the instrument and deliver a good stream through the tubing for draining the instrument, but not to indicate any pressure. The pressure is now slowly raised by pinching the tube between the thumb and index-finger of the left hand. Various pressure regulators have been used, but none give the absolute control which is possible with this simple device. The pressure is, up to a certain point, determined by the tolerance of the patient, as indicated by the pain caused at the moment of distention. It must be sufficient to paralyze the sphincter. If a pressure of 500 mm. will not accomplish this, the pain is discarded as a guide, and dilatation is carried out by the use of dilators of gradually increasing size, sufficient pressure being used to assure each size being distended to its maximum diameter at the cardia. The safety of this method of forcible dilatation is based on the assumption that there is a certain latitude in the size to which the cardia may be dilated between the points at which paralysis of the sphincter and rupture of the esophagus will occur.

Many of the cases are relieved by a pressure of from 50 to 100 mm. The number of dilatations has ranged from one to five, with a few exceptions. In two cases, 7 and 13, in which dilatation of the esophagus was not present, the treatments were repeated respectively seven and eleven times. The cases in which angulation at the cardia was present required more forcible and a greater number of dilatations. Within four or five days after the first dilatation, some food begins to lodge in the esophagus. The first two or three treatments are repeated at intervals of three to four days. The case is not discharged until the esophagus is found free of food rem-

nants at the end of ten days. In the early cases which recurred, this rule was not carried out.

If a fissure is known to exist at the cardia, or if the patient is greatly emaciated, or if severe pain is caused by dilating, an attempt to carry the dilatation hurriedly to the point of giving relief should be avoided, and a pressure of only five or six feet of water

TABULATED REPORT OF FORTY CASES OF CARDIOSPASM

CASE NUM- BER	SEX	AGE	STAGE	DURA- TION, YEARS	DATE FIRST TREATMENT	NUMBER TREAT- MENTS	DATE, RECURRENCE AND TREAT- MENT	NUMBER TREAT- MENTS	SECOND RECURRENCE
5	F.	58	3	5	2-6-06	3	0	..	..
6	M.	18	3	$\frac{1}{2}$	1-20-06	6	7-6-06	4	0
7	M.	29	2	3	1-9-06	6	7-8-06	3	0
8	F.	21	3	3	2-28-06	3	8-1-06	2	?
9	F.	30	3	3	5-12-06	2	0	..	..
10	M.	40	3	5	6-30-06	3	0	..	..
11	M.	30	3	18	6-30-06	10	10-27-06	3	0
12	M.	32	3	5	8-2-06	6	0	0	0
13	M.	33	2	3	8-17-06	10	0	0	0
14	F.	41	3	20	9-20-06	3	0	..	..
15	M.	37	3	5	11-1-06	7	0	..	..
16	F.	24	3	8	11-3-06	6	0	..	..
17	F.	40	2	2	2-20-07	4	6-3-06	2	..
18	F.	42	2	$\frac{1}{2}$	2-27-07	2	0	..	..
19	M.	27	3	7	3-4-07	10	0	..	..
20	F.	25	2	$1\frac{1}{2}$	3-9-07	3	0	..	..
21	F.	57	3	2	3-18-07	5	0	..	..
22	F.	38	3	3	3-20-07	2	0	..	..
23	F.	34	3	2	3-20-07	4	0	..	..
24	F.	41	3	26	4-20-07	4	7-3-07	3	0
25	M.	38	3	7	4-25-07	6	0	..	..
26	M.	29	3	15	4-28-07	8	10-27-07	3	0
27	M.	29	3	2	5-15-07	7	8-3-07	3	0
28	M.	21	3	6	5-15-07	5	11-11-07	3	..
29	F.	31	3	4	6-5-07	10	0	..	..
30	M.	38	2	2	6-8-07	6	0	..	..
31	M.	33	3	$1\frac{1}{2}$	7-19-07	5	0	..	..
32	F.	18	3	3	9-6-07	10	1-8-08	4	..
33	M.	46	3	12	9-10-07	6	0	..	..
34	F.	38	3	2	10-13-07	6	1-3-08	3	..
35	F.	32	3	7	10-13-07	3	0	..	..
36	F.	34	3	9	10-19-07	5	0	..	..
37	F.	21	3	3	10-26-07	2	0	..	..
38	M.	47	3	2	12-23-07	3	0	..	..
39	F.	17	2	1	1-3-08	4	0	..	..
40	F.	62	3	20	1-6-08	4	0	..	..
41	F.	38	3	6	2-2-08	5	0	..	..
42	M.	59	3	15	2-5-08	2	0	..	..
43	M.	19	2	4	2-10-08	3	0	..	..
44	F.	38	3	3	3-6-08	2	0	..	..

employed. This will give relief for a few days at a time, and allow the healing of a fissure or ulcer. Later, the dilatation can be carried to the point of producing sufficient paralysis to effect a permanent cure.

In those cases in which the olive can be passed through the cardia, the dilator enters with equal facility. In those cases in which difficulty was encountered, it was overcome by the same methods which were used in passing the bulbous sound. In the recent cases I have invariably used the silk thread, as it makes the passage of the instrument more rapid, safe, and certain.

In two cases of long-standing cardiospasm without dilatation, it was some time before I succeeded in dilating the esophagus or recognizing the cause of failure. In these cases the upper portion of the dilator cannot fully expand, and hence the portion within the stomach acts as an expanding wedge, drawing the instrument down. If the staff is held firmly against the incisor teeth, the diaphragm is drawn up to its limit and the cardia then dilated.

The immediate results are most striking. The patients are almost invariably able to take any kind of food at the following meal. There is often a complaint of soreness for the first twenty-four hours. The gain in weight and strength is rapid; even in those cases which were apparently well nourished there has been a gain in weight from 10 to 40 pounds. Attention is called to the tabulated history, in which the number of treatments and recurrences may be noted. In 29 cases there has been no recurrence. Marked return of the symptoms has not occurred in any case, as all were cautioned to return on the slightest evidence of trouble. That the disturbance has recurred in so few cases has been a constant source of surprise. Among those more recently treated there will undoubtedly be some recurrence, but I think that recurrences will be rare in the cases which have remained free from trouble for two years or more. The cases which I have had opportunity to examine at some time after treatment show that there is a tendency for the dilated esophagus to return to its normal size. As far as possible these cases will be followed up and the ultimate results reported.

GASTRIC ULCER AND CANCER *

By CHRISTOPHER GRAHAM

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In offering this paper to the State society I have in mind chiefly to present the past year's (1905) experience which bears upon the etiologic relationship that exists between ulcer and cancer of the stomach.

In the later nineties our attention was strongly attracted by the many long histories of "dyspeptic" trouble that preceded cancer of the stomach, and the thought that ulcer was this precancerous condition became firmly implanted. Since that time this class of cases has been followed out with more or less care and from time to time placed before you for consideration. Each succeeding year has strengthened our belief and with the more careful pathologic examination of the excised parts we stand to-day on firmer footing.

The clinical histories have not held to so high a point as they did the first three years, but the average for the whole term is still about 60 per cent. While the clinical evidence falls somewhat, the pathologic is quite remarkable.

In 1903 we demonstrated pathologically that 15 per cent. of gastric cancers had ulcer base and in 1904 this percentage easily reached 18. This, added to our clinical record, was satisfactory to our hypothesis. The year 1905 has presented its clinical proof in a fairly definite manner; a little less than one-half (47 to 49 per cent.) of the cases have histories ranging from three to thirty-seven years' duration. If to these we add those of two years' standing, the percentage reaches 61.

* Read before the Minnesota State Medical Society, June 21, 1906. (Reprinted from the "Boston Medical and Surgical Journal," vol. clv, No. 8, pp. 193-195 Aug. 23, 1906.)

Convincing and satisfactory as a long precancer history may be, it is not necessary that it shall be manifest in order to declare that ulcer was the precursor; first, because cases with short histories and absolute pathologic proof are multiplying daily; second, because attacks may be weeks, months, years separated and the earlier disturbance quite forgotten in the present severer form. These long periods of latency are quite frequently noted when carefully developing the history of an annoying condition; third, many cases of hemorrhage, perforation, and obstruction have had no previous history whatever, or, if any, they are brief and slight, and yet the lesion proved to be ulcer of long standing. Cancerous change may take place in these latent forms, and the first symptoms may be manifested only when obstruction, hemorrhage, perforation, or poisoning has advanced to a decided degree. Fourth, cancers with a history of one to six weeks, yet so advanced that an operation cannot be undertaken, can scarcely be considered as lacking a period of latency of some nature.

In view of the fact that ulcer may, and often does, have a latent period of years; and that cancers with short (manifest) histories frequently do show old ulcer base, it seems just to assume that many, if not all, rapidly developing gastric cancers have found a fertile soil on a previously developed ulcer area.

Though perhaps not yet absolutely demonstrable, it seems to me that hyperchlorhydria (or hypersecretion) precedes ulcer and is a constant causative factor, and that ulcer is the precursor of cancer; at any rate the histories are often typical of this and the findings abundant in proof.

In eliciting the history of gastric cancer there are three types found: (1) Those in which the initial symptoms were slight and a long latent period has intervened; (2) those in which the acute symptoms seem suddenly to attack the patient in the very midst of health; and (3) those with a long series of repeated attacks which are evidently precancerous. In the first and third the precancerous history is that of ulcer; what the precursor is in the second is being determined through surgery and skilful pathologic technic.

Basing conclusions on the many histories taken at our clinic, I

would distinguish between *four* stages in gastric ulcer development, and would expect cancer when it did develop to appear in the third or fourth stage, more often in the fourth stage.

1. In the first stage of ulcer the patient unusually has good appetite with nutrition at par or even excessive; pain two to five hours after meals; when the stomach is empty or emptying itself; the heartier the meal, the longer and more complete the sense of stomach satisfaction (over-active digestion), perhaps some gas and sour eructations; occasional vomiting of small amounts of sour, bitter liquid; stomach normal as to position and size; excess of hydrochloric acid, otherwise normal. These patients present themselves to be relieved of pain, which they say comes after meals, but which, in reality, is pre-meal pain.

2. The second stage may be established some months later, following several intermissions with recurrences, each increasing more or less in severity; appetite good, though perhaps not above normal; less satisfaction follows the hearty meal; pain is severe and comes sooner after food; distress or discomfort may be present even when so-called pain is absent, gas is usually complained of; sour eructations common; vomiting of sour, bitter, acrid fluid, at times mixed with food, is frequent; a sense of relief follows vomiting for a greater or less period; loss of flesh often noted during the attack, either through voluntary or prescribed dieting; rapid gain takes place during intermission. Perhaps some dilatation; acidity high or normal.

3. In the third stage desire for food may remain; it may be fair or decreasing, but the patient is afraid to eat because of distress, pain, gas, vomiting, sour eructations, bloating, or sour, burning stomach; there is but short food relief, if any; perhaps obstructive symptoms; loss of flesh usually occurs, and cachexia may be present. Constipation, marked in all stages, is usually obstinate here. Stomach dilated and prolapsed, hydrochloric acid normal, lessened, or even absent; blood may be found during any stage at test meal, but more frequently here than previously, because, other conditions being equal, the chemical and mechanical powers of the stomach are such that blood destruction (digestion) is retarded.

It is often extremely difficult to mark the distinctive period of transition of the third stage, which is ulcer, into a fourth which is cancer, so imperceptibly may it take place. Some patients are weak, emaciated, and even cachectic, with ulcer the only lesion (1) if the motor power of the stomach be greatly interfered with, or (2) if the lesion be large and destruction great even in the presence of mild obstruction. Here the transition may begin, and though all possible diagnostic means and precautions are taken, yet sometimes a differentiation cannot be made until wide-spread degeneration removes all hope of cure. But when the clinician is awakened to his important task, he will at least reach the point of honest suspicion and call legitimate surgery to his aid.

Many times one does find symptoms that offer a basis for differentiation. Pyrosis increases in amount, but is, perhaps, less acute in character. Often on stooping, or during the night, fluid which has some acidity pours from the stomach and awakens the patient; gas, bloating, and a distended discomfort increase. Pain, nausea, and vomiting are more constant and more often excited by liquid food, but the pain is usually less intense; appetite may persist to quite the end, but, as a rule, it gradually lessens until finally the patient may turn from food with nausea. Nervousness and languor are combined; weakness and faintness creep on; the patient's ability to exert himself decreases rapidly; anemia may come speedily; the flesh wastes decidedly; a languid air, paleness about the eyes, nose, and mouth, associated with a pinched expression (a toxemic look), are common. All this points directly to a transition.

The character of the pain changes; it is dull, sickening, more continuous but not so regular in recurrence, and more wearing. The severer attacks come at unexpected times, as a rule, sooner after food, and are not so acute. There is more relief from eructations of gas and vomiting. The pain is more diffuse and not so often eased by pressure or position. Localization of pain, though not always very definite in ulcer, is much less so in cancer. As in ulcer, if perforation has taken place there may be a wide field of radiation, otherwise the epigastrium is the seat of pain. As cancer

progresses diffuseness of pain increases. The diagnosis must, however, occasionally be made in the absence of pain.

Vomiting, always a prominent symptom, usually intensifies as malignancy creeps on. It is more irregular, longer between attacks, more copious (unless there be a contracted stomach from diffuse infiltration), and gives even more relief; the vomitus is rancid, often foul, acid and obnoxious; all these symptoms vary in intensity according to obstruction and destruction; but the chief characteristic of cancer vomiting is that food taken several hours or even days before returns poorly macerated and with undigested masses in it, and this perhaps even when pyloric obstruction is slight (cancer paralysis). Vomiting is, as a rule, accompanied with less retching in cancer than in ulcer, and blood is more frequently seen, though in small quantities; mucus is, perhaps, oftener seen, while bile is a rarer accompaniment. If there has been a long period between the ulcer symptoms and the recent cancerous change (Type 1), the diagnosis is usually easier because of the constancy, the rapid approach, and marked character of the symptoms. There may be a short but persistent period of flatulence, bloating, lessened appetite, and loss of flesh, and then the sudden burst of malignancy so often remarked in the other type (Type 2) that clinicians say attacks the patient in the very height of good health. In these two types we most often meet tumor, and in many other respects they are so similar that we are led to consider them counterparts—the early symptoms in the one being overlooked or forgotten by the otherwise healthy individual.

Motor power lessens rapidly as cancer progresses, and if pyloric obstruction is acute and the other symptoms are intense, *dilatation* advances rapidly; organic acids increase and hydrochloric acid decreases and blood is more often and more easily detected. Finally, it is the (general) composite pathologic picture that the patient presents at the clinic quite as often as the symptoms he urges upon you that fixes the period when the benign has yielded to the malignant (condition).

Fourth, when we reach the undoubted fourth stage (cancerous) the whole picture intensifies, "and he who runs may read." The

appetite is poor or absent, even the smell of food may be repulsive. Meats and fats are especially avoided. Emaciation follows rapidly, often more so than can be accounted for by loss of appetite (toxic or perhaps food delay); strength decreases, languor is intense, and the patient exerts himself with difficulty; the anemic-cachectic condition develops more and more clearly. The body becomes emaciated, the skin dry, wrinkled, and lemon-yellow. Pain increases and is constant, boring and undermining, less acute, and more sickening; food, if tolerated, almost immediately increases it; frequent vomiting of quantities of poorly macerated and undigested food, rancid and offensive, coffee-ground color; blood more copious, oftener and more easily detected because of the further decreased or absent motor power; sour stomach, sour eructations and gas become distressing; obstinate constipation, mental depression, extreme languor, cachexia, prolapse, dilatation, tumor, lactic acid fermentation, absence of hydrochloric acid. When these are present, the condition scarcely remains in doubt.

The picture of cancer where no obtainable precancerous symptoms are elicited, or where a long period has elapsed since symptoms are recalled, is practically that of the late stages of those with long preceding history. One must be ready to diagnose cancer of the stomach with one or few symptoms, the general condition and pathologic picture of the patient bearing out the meager findings.

In our series of cases the males and females ran in proportion of 4 to 1, and ranged in age from twenty-nine to seventy-six years, the average being a little over fifty. About three-fourths of the whole number presented themselves for amelioration of symptoms that had been pressing, for one year or less—that is, previous symptoms had not been so alarming that medical aid had been anxiously sought, or, to put it fairly, malignant manifestations had been present for only one year or less, the average being a little less than five months. Twenty-three (23) of the number that presented long histories complained of malignant symptoms only a year or less, the average in this number being a trifle more than five months. This seems to have a significant bearing—the same soil in each instance.

In the 1905 series pain was rather constant. In 8 the histories did not state either way, one said no pain, the remainder (73) openly declared for pain.

Vomiting was not recorded in 11 histories, 3 stated no vomiting, while the great number (68) complained more or less severely. In 42 the lesion was situated at the pylorus or lesser curvature, 3 at the cardia. The location was not recorded in many of the inoperable cases, but the symptoms, for which the operation was undertaken, most often spoke for pyloric end or lesser curvature location.

Of the whole number operated upon, 67 had test-meals and other routine stomach examinations, chemical and physical. Tumor was present 27 times and doubtful in 3 more. Dilatation present was 54 and obstruction 36 times. In 32 free hydrochloric acid ranging from 1 to 50 was present, combined in 32; lactic, 42; fatty, 19; both hydrochloric and lactic, found 13 times. Blood was found often. During the last eight or nine months there were but 10 patients in which it was not found at test-meal. The preceding three or four months it was not so often found, doubtless because of less careful technic.

There were 39 cases in which a portion of the stomach was removed and submitted to the pathologist for macroscopic and microscopic examination, a full report of which he has in preparation. I here give in brief the results: In over half (54 per cent.) (21 in number) the pathologic evidence was good that cancer had developed on an old ulcer base, in one-fourth (25.60 per cent.) (10 cases) the evidence was fair that the same was true, while 8 gave no evidence of preceding ulcer irritation. Then in over three-fourths (79.5 per cent.) the pathologic evidence was good or fair that ulcer was first as a cause. Twenty-one (21) of the thirty-nine (39) had long histories, fourteen (14) of which gave good pathologic evidence, six in which the histories were long, gave evidence considered only fair, 7 cases whose histories ranged from two months to two years gave good pathologic evidence, and 4, the histories of which covered from one and one-half months to two

years, offered fair proof. Histories and pathologic findings ran together, both positive in over half (54 per cent.) the cases.

The above figures seem to emphasize two points: (1) That short histories and ulcer as the old lesion on which cancer is engrafted are not incompatible, as some argue. (2) That ulcer is the great and fertile soil of cancer.

CONTRIBUTIONS OF SURGERY TO A BETTER UNDERSTANDING OF GASTRIC AND DUODENAL ULCER *

By WILLIAM J. MAYO

Contributions of surgery to our knowledge of ulcer of the stomach and duodenum are numerous and of high value, and, taken in conjunction with the recent work in experimental physiology of the digestive system, are throwing much-needed light upon this obscure malady. In the past we have depended upon notoriously defective clinical examinations, supplemented by chemical and biologic investigations of the gastric contents. These methods, while teaching some truths, often failed to demonstrate the actual condition present. Neither did postmortem revelations give a clear picture of the situation during the curable period on account of secondary complications and terminal infections.

It is the purpose of this paper to examine the subject from the standpoint of the operating-room results, with a view of somewhat modifying the generally accepted opinions.

Ulcers of the stomach and duodenum can be divided surgically into two classes. First, the indurated or calloused ulcer, which can be seen and felt during operation, because of the cicatricial tissue which gives the appearance and "feel" of a scar from the outside of the stomach wall. All the positive advances in surgical knowledge concern this group.

The second class has for its type the non-indurated mucous ulcer, which cannot be identified from the outside of the stomach or duodenal wall. The site of the ulcer does not betray its presence by thickening or other sign, and it is usually located with much diffi-

* Read before the Congress of American Physicians and Surgeons, May 8, 1907. (Reprinted from "Annals of Surgery," June, 1907.)

culty even if the stomach and duodenum are opened and careful search made of the mucous membrane. We have on several occasions resorted to direct operative inspection when bleeding has been an important symptom, and have not always found it easy to discover the small mucous fissure which was responsible for the trouble.

Nearly all the failures of surgery of the stomach are to be found in this group of so-called clinical or medical ulcers; because, (a) the ulcer is not located and many times its existence is problematic; (b) the condition is often confused with pyloric spasm, atonic dilatation, gastropnoxis and the gastric neuroses, or other morbid non-surgical conditions; (c) the ulcer does not give rise to mechanical interference with the progress of food, which would introduce an operative indication.

The value of surgical contributions to our understanding of non-indurated ulcer is negative rather than positive in character and consists in teaching us errors in diagnosis and pointing out lines of future progress.

Location of Indurated Ulcer.—The relative frequency of ulcer has been placed at about 10 gastric to 1 duodenal. In St. Mary's Hospital between July 24, 1905, and March 23, 1907, 200 cases of ulcer were operated upon. Of this number, 87 involved the stomach, 98 the duodenum, and 15 were independent ulcers of each viscus; showing that ulcers which can be actually recognized are fully as often found in the duodenum as in the stomach. How can this apparent discrepancy between the older statistics and these facts be explained?

The terminal three-fourths of an inch of the pyloric end of the stomach, the so-called canal of Jonnesco, does not take part in the grinding function of the antrum and is to be considered with the pyloric apparatus. It is therefore less exposed to the acid gastric contents and to mechanical injury.

Ulceration of this canal is uncommon. The large majority of gastric ulcers involve the lesser curvature above the pylorus and extend downward anteriorly and posteriorly in a manner which we have compared to a *saddle*. Frequently an anterior and posterior

ulcer thus exist connected across the lesser curvature by a bridge of cicatricial tissue. The posterior ulcer, as a rule, is the more extensive.

The typical duodenal ulcer is to be found in the upper inch and a half of the duodenum, and in 96 per cent. of the cases extends up to or within three-fourths of an inch of the pyloric sphincter. The deepest part of the ulcer will usually be found just below the py-

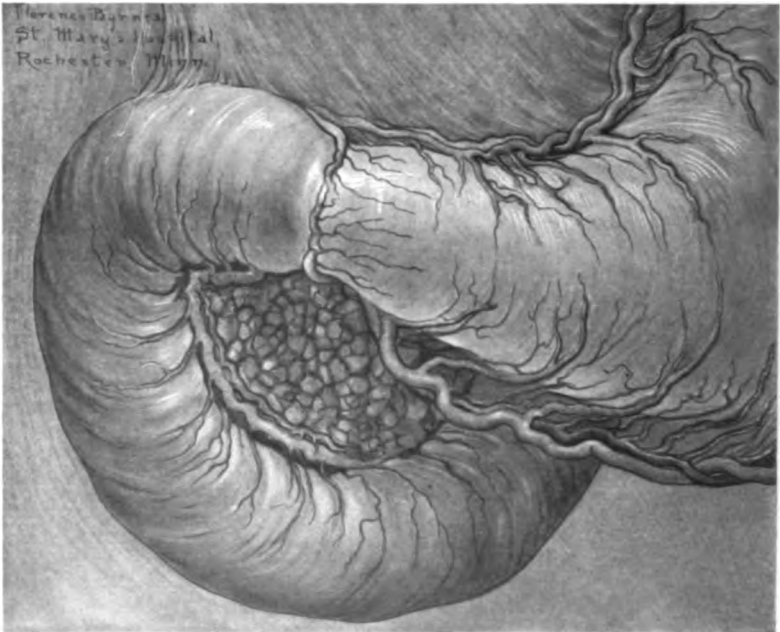


Fig. 8.—Showing relations of blood-vessels about pyloric end of stomach and duodenum, with special reference to pyloric vein.

lorus, where the acid chyme, which is ejected with considerable force from the stomach, produces an impact upon the intestinal mucous membrane.

The fact that the ulcer extends up to and often involves the pyloric sphincter on the duodenal side, has led to the erroneous belief that the ulcer was pyloric, therefore gastric, and the statistics have

been compiled on this mistaken identification. In the presence of an ulcer and with the parts more or less fixed by adhesions, it is often a difficult matter to actually determine the location of the pylorus. The best means of identifying it consists in the arrangement of the blood-vessels, which is quite striking. A thick-walled vein is to be seen extending from the inferior margin of the pylorus on the gastric side, upward and across about three-fourths of its

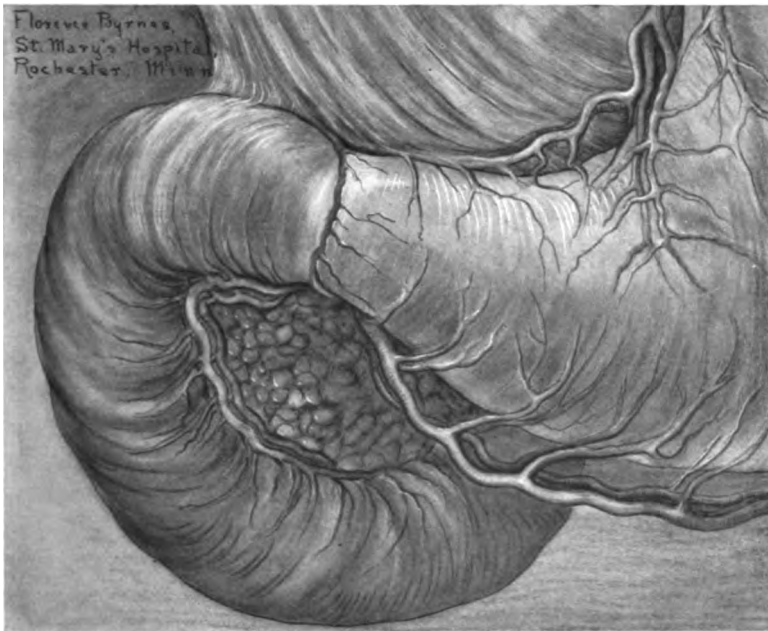


Fig. 9.—Location of pylorus by means of the blood-vessels. Pyloric vein.

extent. From the superior margin a similar vein extends downward until it nearly or quite meets the one from below (Fig. 8). There are several variations from this which are shown in Fig. 9.

Relative Frequency of Indurated Ulcer in Male and Female.—It has been accepted as a fact that ulcer of the stomach, including the unidentified ulcer of the duodenum, is more common in woman

than in man. Osler quotes the large statistics of Welch and others, showing that 60 per cent. are to be found in women. The Fenwicks, on the contrary, give the proportion as nearly 80 per cent. in men. In Seymour Taylor's collection of 100 cases, he found 72 per cent. in men. In the operating room we found that 62 men were operated upon for gastric and duodenal ulcer to 38 women. On analyzing this percentage, however, it is to be noted that duodenal ulcer is found 77 times in men and 23 times in women, while in true gastric ulcer the percentage runs nearly even—52 men to 48 women; so that the percentage of male over female is due to the peculiar frequency of the duodenal ulcer in the male, and it is worthy of note that the percentage of gall-stone disease is 76 per cent. in women to 24 in men, the reverse of the statistics just given for duodenal ulcer.

Duodenal ulcer occurs well above the common duct with its alkaline secretions. The curve of the duodenum in men is usually higher than in women; that is, the first portion of the duodenum in men is nearly always ascending, while in women it is often transverse. It seems probable that, for mechanical reasons, the alkaline secretions of the liver and pancreas more readily neutralize the acid chyme in the upper duodenum in women than in men.

Relation of Indurated Ulcer to Cancer.—In 54 per cent. of the 69 cases of cancer operated upon in 1905 and 1906, by Dr. Charles H. Mayo and myself, the clinical histories and pathologic examination of removed specimens made it certain that the cancer had its origin in ulcer. Fütterer has demonstrated the development of malignant disease in portions of the gastric mucosa which had become separated and buried in scar tissue. The thick mucous membrane of the stomach, with its deep rugæ, is particularly subject to chronic irritation. In 80 per cent. of the cases the cancer had its origin in the pyloric end of the stomach, where the mucous surface is exposed to trauma, although the antrum has but one-sixth the total area of the gastric mucous membrane. The topography of ulcer and cancer are, therefore, the same.

We have seen but 3 cases of primary carcinoma of the duodenum. In one of these it seemed certain that the malignant disease had its

origin in ulcer. In the second it was possible, and in the third the extent of the disease did not permit of a sufficiently thorough examination upon which to base an opinion.

Cancer of the duodenum is a rare malady, and its etiologic relationship to ulcer is apparently not important. Three times, however, we have found cancer of the stomach developing upon the margin of a duodenal ulcer which had extended up to and invaded the pylorus, showing the susceptibility of the stomach to carcinoma as contrasted with the duodenum.

It is possible that the surgical conception of the frequency of gastric cancer developing upon ulcer exceeds the facts, as in a considerable percentage of our gastric resections for cancer the operation was begun with the belief that the disease was simple ulcer, and on exploration cancer was found engrafted upon it. The patient who has suffered long from ulcer is more willing perhaps to submit to operation at an early date than are those who have not previously been afflicted with gastric disorder. That cancer frequently develops upon an ulcer base, however, must be admitted.

Non-indurated Mucous Ulcer.—The important advances which have been brought out through surgical inspection of actual diseased conditions during life, which we have been considering, are based entirely on the fact that there is an ulcer present; that it is indurated; that about it there is a scar and other evidences which are so tangible there can be no question that the disease actually exists. We now come to study a second class, in which the lesion is not demonstrated and the evidence that it exists is based upon notoriously defective clinical examinations. The lesion is supposed to be mucous, and therefore not to involve those external gastric and duodenal envelopes which would lead to accurate identification. The operation is undertaken upon an unproved hypothesis, and the results of the application of surgery to such indefinite conditions throw still further doubt upon their actual existence.

That an *acute* non-indurated mucous ulcer does exist cannot be questioned. Evidence furnished by direct surgical inspection, by

the operative repair of acute perforations, and by operations for acute hemorrhage, demonstrate the fact which has been further attested to by postmortem investigations of deaths from such acute conditions. Does there exist *chronic* non-indurated mucous ulcer, or is the belief in such a condition based upon our knowledge of acute ulcer and the inability to find chronic ulcer clinically diagnosed? The whole subject is so interwoven with fact and fancy that at the present time it is nearly impossible to secure reliable data with which to lay bare the truth.

In contrasting the two groups, we find that *chronic indurated ulcer*, as a rule, produces certain phenomena. In the early stages there may be no mechanical symptoms, the distress being occasioned by the food and excessively acid gastric secretions passing over the sensitive ulcerated surface. In the course of time partial healing and development of large amounts of cicatricial tissue about the ulcer base lead to more or less interference with the progress of food, and if this amounts to retention the character of the symptoms change and become characteristic of obstruction. Evidences of blood are helpful, but not essential to diagnosis.

Chronic non-indurated mucous ulcer, if it exists, is certainly indefinite in its symptomatology. Pain, gas, distress after eating, and moderate stagnation of food, with pyloric spasm, constitute the accepted chain of evidence. The nature of the supposed lesion does not lead to the formation of scar tissue, and, as a matter of fact, the symptoms are not only vague, but they are equally characteristic of non-surgical conditions. The actual demonstration of blood, in our opinion, is necessary to even give the evidence a standing in court.

Of all misleading symptoms, pyloric spasm is the most mysterious. The term is given to an intermittent pathologic contraction of the pylorus and antrum. Some authors seem to consider it a definite entity having a pathology of its own; the large majority of observers, however, look upon it as a symptom. The interesting and important question is, does it indicate ulcer?

In our experience, pyloric spasm is not regularly seen in indurated

ulcer, but is an habitual accompaniment of certain other morbid conditions.

The derivatives of the primitive foregut consist of the posterior wall of the pharynx, the whole of the esophagus, the stomach and duodenum to a point just below the common duct, the liver and pancreas being offshoots from that part of the foregut which is to become the upper duodenum. All of these organs are concerned in the preparation of food for absorption, but do not themselves absorb. Looked at from this standpoint, we have the explanation why the first four inches of the duodenum is associated both in its physiology and pathology with the stomach. The duodenum below the common duct, the jejunum, ileum, cecum, and the colon to the middle of the transverse if not to the splenic flexure, is derived from the midgut and is concerned in absorption.

Kelling, Cannon, and others have demonstrated beyond a doubt that the control of the pyloric apparatus is largely vested in the duodenum. We have reason to believe that to a certain extent this control can be exercised by all of the just named derivations of the midgut.

We have seen most marked pyloric spasm giving definite signs and symptoms of supposed mucous ulcer, and upon exploration have found gall-stones or appendicitis, or tuberculosis of the cecum. On all of these occasions the real seat of the disease was obscured by the stomach symptoms occasioned by the irregular pylorospasm. These experiences have been so numerous that we look upon pyloric spasm as an indication of an irritation in some part of the intestinal canal which causes an irregular attempt to close the pylorus and thus prevent food from entering the disturbed area. It can be aptly compared to the miner's sluice canal, the sluice gate being controlled by a pulley. Upon necessity for canal repairs the gate is closed, the disturbance appears at the top where the water is prevented from entering the canal.

We have never seen pyloric spasm in connection with diseases of the terminal portions of the bowel which are derived from the hindgut. How is this control of the pyloric sphincter brought about? The explanation of this may be found in those splendid experi-

mental studies of the physiology of the digestive tract which have been given to the world by Starling, Pawlow, Cannon and others. Briefly, it would appear that the maintenance of the body is to a large extent independent of the cerebrospinal system.

The stomach is partially controlled by the central nervous system through the effect on this viscus of sight, taste and smell of food, and also by the feeling of repletion which follows the full meal. Intermittent elimination of waste products from the sigmoid and rectum is more or less under conscious control. Through the plexuses of Meissner and Auerbach, acting conjointly with the sympathetic ganglia, the central nervous system has some minor influence on the intervening intestinal tract, but to a large extent the digestive system is still controlled by those primitive chemical messengers which Starling has named "hormones," aided by the sympathetic nervous system.

Hormones are the earliest of all forms of stimulation, and are perhaps the most important agents in the control of digestion. An example is the effect of "secretin" in the stimulation of the pancreatic secretion. Chemical stimulation is undoubtedly the most important factor in the movements of the stomach and intestines, acting as it does directly upon the gastro-intestinal muscle fiber, and is the cause of peristalsis.

The curious blending of the sympathetic with the ductless glands, which produces hormones, is exemplified in the adrenals, thyroids, parathyroids, etc., the products of which have gone under the name of internal secretions. We may here possibly get an explanation of that close association which exists between pyloric spasm, atonic dilatation, prolapse of the stomach, and the gastric neuroses which have so often masqueraded as chronic non-indurated mucous ulcer. Be this as it may, the clinical fact remains that, for various reasons, operations based upon the belief or actual existence of chronic mucous ulcers have as a class been unsatisfactory; not that the mortality has been high, but living through the operation has in a large majority of instances either failed to give relief or has introduced new elements of discomfort.

A BETTER UNDERSTANDING OF GASTRIC AND DUODENAL ULCER 67

At the present time we do not consider that a diagnosis of mucous or other undemonstrated ulcer indicates a surgical operation without there exist complications such as perforation, hemorrhage, or obstruction.

DIFFERENTIAL DIAGNOSIS BETWEEN DUODENAL ULCER AND GALL-STONE DISEASE *

By CHRISTOPHER GRAHAM

In gall-stone disease and ulcer of the duodenum we have two of the principal lesions of the upper abdomen. Because of their frequent occurrence, intimate relation, and similar type of symptoms, they often lead into great difficulties in differentiation.

In our clinic 163 cases of duodenal ulcer have come to operation. (June, 1906.) I here consider 141 which have tabulated histories. Two-thirds of this number (67.4 per cent.) were fairly diagnosed. One-tenth (10 per cent.) were called gall-stones; one-seventh (14.3 per cent.) were thought to be either gall-stones or duodenal ulcer. Of those remaining the diagnosis was not stated or they were variously diagnosed as one of three or four different ailments.

The gall-bladder cases have run a higher percentage of correct diagnoses; four-fifths (86.5 per cent.) we have met satisfactorily; about one-sixteenth (6.9 per cent.) were called either ulcer or gall-stones, while the remainder were called gall-stones or appendicitis (5.6 per cent.) or duodenal ulcer (1 per cent.). It is well to notice here that in about seven-ninths of those cases in which ulcer of the stomach was seriously considered there was duct obstruction and adhesions or some form of chronic trouble. Despite the most painstaking care in history development and clinical observation there will yet remain a rather large number of ulcer cases that cannot be differentiated from gall-stone disease; the same may be said of the gall-bladder, but in a less degree. More especially

* Read in the Section on Practice of Medicine of the American Medical Association at the Fifty-seventh Annual Session, June, 1906. (Reprinted from "The Journal of the American Medical Association," Feb. 9, 1907, vol. xlviii, pp. 515-517.)

will this be true if the clinician is determined to meet surgical indications in both cases when most opportune for his patients.

It is the early gall-stone and early acute type of ulcer, with spasm and perforating tendencies, whose histories are oftenest confounded. Some chronic gall-bladder patients, however, may so complain that stomach lesions seem positive. Still fewer chronic ulcer patients will present symptoms not to be differentiated from biliary calculi unless perforations repeat; that is, early ulcer of the duodenum is oftener mistaken for gall-stone trouble than is early gall-stone for acute ulcer of the duodenum, while in the chronic stage of both conditions gall-stone trouble has oftener been diagnosed ulcer than has the reverse been done.

SYMPTOMATOLOGY

The symptoms of these two conditions run very nearly the same as to kind, and the field of complaint is often identical—pain and distress, gas, belching, eructations, vomiting, sour stomach (oftenest in ulcer), jaundice (much more frequent in gall-stones), hemorrhage (much more frequent in ulcer), general weakness, and nervous irritability. Condition of the bowels and state of nutrition are frequently determining factors. It is the interpretation of these symptoms as they appear singly or combined on which a differentiation depends.

Pain.—Pain in cholelithiasis is usually sudden of onset, with the mid-epigastrium as center. It may have a wide field of radiation, usually to the right costal arch and scapular region. It is severe and lancinating, and spasm of diaphragm is usually observed. The pain comes absolutely irregularly as to time, is independent of and not eased by food, nor often traced to it as a cause. Great anxiety and free perspiration accompany the severe attacks and chills and fever may be observed. Gas often troubles during the attack and gives the sensation of upward pressure, often extreme. Vomiting is frequently present, but relief is not so certain to follow in gall-stones as in ulcer; hot applications often give a certain amount of comfort, but only morphin or natural return to health stays the terrific pain. Fully as characteristic as is the onset is the rapid

disappearance, even at the height of pain, with almost immediate return to normal health. When the above symptoms prevail and no complication has arisen, because of repeated attacks, gall-stones may be reasonably considered as the cause of disturbance.

In duodenal ulcer the pain runs in decided periods of attack, lasting from a few days to several months, may, and often does, come suddenly, usually occurs daily, or several times a day during this period. It is burning and gnawing in character, and if perforation has not complicated affairs or spasm has not been marked it less often reaches the sharp lancinating type of gall-stone colic. In the greater number of cases the pain is caused by the irritant action of the acid-acrid contents on the ulcer area of the duodenum (or stomach) itself, heightened by the accompanying spasm and gas formation. In the lesser number it is due to perforating peritonitis, a complication more frequent in duodenal than in stomach ulcer, because of the thinner walls of the duodenum. Pain is at its height from two to five hours after food or just preceding meal hour, and the field of radiation is usually limited to the stomach and duodenal areas. It entirely disappears or is quieted for a time by food, drink, alkalis, vomiting, or irrigation; that is, anything that diverts, dilutes, neutralizes, or removes this acid liquid brings relief to pain as well as to most of the other distressing symptoms. Until obstruction approaches the easiest moments are those immediately following a meal or when the stomach is wholly emptied by vomiting or irrigation. Continuous distress is rarely met unless motor power is decidedly lessened or large ulcers elsewhere add their baneful influence. In both conditions peritonitis often gives pronounced rigidity and great tenderness, but in perforating ulcer they are usually much more persistent. Spasm of the diaphragm is rarely caused by pain of ulcer.

Gas.—Gas as a factor in gall-bladder pathology is of little moment. It is often present during the intense spell, and some relief is usually experienced if it is eructed, but the bloated, distended, bursting sensation that so many experience is due to the character of the pain and its radiation rather than to gas, as is supposed by so many sufferers.

In duodenal ulcer the history of gas formation is almost as valuable as is that of pain, and frequently on this factor alone a diagnosis depends. This may be the first sign to call attention to a deranged digestion. It appears before obstruction in any degree can be demonstrated, and it surely comes as soon as motor power is appreciably lessened. Few, indeed, are the patients in whom gas is not mentioned as a distressing feature. It is at its height when the pain is greatest, from two to five hours after meals, and may be the cause of the distress, the result of overdistention of the stomach. The same measures relieve gas that relieve pain—food, drink, alkalis, vomiting, and irrigation. The greater the degree of acidity, the greater the degree of discomfort from gas as well as pain, and it is only in those cases of ulcer in which acidity is not increased or is diminished and obstruction is absent that gas and pain are not complained of, because, first, the irritant to the membrane is then lacking, and, second, spasm is not induced.

Vomiting.—Vomiting is common to both troubles, and should be of less importance than the two already considered, because in the early stage of each disease, when diagnosis should be made and treatment instituted, vomiting is not so frequently a significant factor. In gall-stones it appears soon after the initial pain and may give more or less relief; it is profuse only if the attack comes on soon after a meal, and then the normal food and normal acid condition will be recognized. Usually the intense nausea produces severe retching, followed by a greenish, bitter fluid and mucus.

A very different picture is present in ulcer. In the earlier stage nausea and eructation are oftener present than is vomiting, and when in the earlier history it is present it is rarely profuse, is acid-acrid, and bitter-burning. For a time relief follows vomiting. As the trouble progresses the picture intensifies, until vomiting may become not only distressing, but threatening. It varies in time, intensity, and quantity. Rarely, indeed, does it come immediately after food, and only then, if there is much stasis and the meal has over-burdened the remaining stomach capacity. Usually vomiting begins from two to four hours after food, when pain and

gas are greatest, and, unless hypersecretion is present, dilatation marked, or obstruction advanced, the amount is not great, but irritating. Just as often we get a history of daily vomiting, or every second or third day, a few hours after the evening meal; then the pain is marked, the quantity of vomit is large and frequently so eroding that the teeth suffer. Relief follows this copious amount, until added ingesta and stomach secretions again lead to a similar condition. These are the cases in which motor power is decreased either through dilatation, obstruction, or other cause; that is, the train of vomiting varies as does the degree of dilatation, amount of obstruction, and quantity and acidity of secretion. Also the kind and amount of food is a factor; acids (salts and less often sweets) are the ones most frequently left from the diet list. The sufferer usually traces the complaint to the food, and, unless there is obstruction or marked dilatation, he too often fails to find relief through diet, though he may find amelioration.

Hemorrhage.—Hemorrhage in gall-stones is rare and may be an accidental accompaniment. In ulcer it is not infrequent, but we must be ready to diagnose ulcer of the duodenum without hemorrhage, or many of our patients will suffer unto death. Blood varies from mere traces found while irrigating the stomach to huge quantities vomited or passed by the bowel. By this single manifestation of ulcer we must occasionally make our diagnosis, for blood from the stomach in an otherwise healthy person should be taken as evidence, even when all so-called dyspeptic symptoms are wanting. When passed by the bowel, it is usually dark, tarry, granular, and will rarely be mistaken for hemorrhage lower in the tract. Fainting and collapse with sudden anemia accompany decided hemorrhage of the stomach, and even when not in great amount the effect may be profound.

Jaundice.—Jaundice in gall-stones, like hemorrhage in duodenal ulcer, ought not to be waited for. In duodenal ulcer it is rare, following only when the papillary area is invaded or, after perforation, when adhesions have formed and complicated the gall-ducts. This condition, however, is not frequent. In neglected gall-bladder trouble jaundice follows: (1) the forcing of a stone

into the common duct; (2) inflammation of the ducts; (3) pressure of stones within the gall-bladder on the common and cystic ducts at their junction; (4) swelling of the pancreas and resultant pressure on common duct; (5) perforation and adhesions. When jaundice follows sudden and severe pain in the gastric or gall-bladder area with radiation backward, one can make no intelligent diagnosis save gall-stones. If ulcer exists, nothing but a guess will make the differentiation, except surgical measures.

Condition of Bowels.—This is a distinct factor in the diagnosis of duodenal ulcer. Often the patient will complain of constipation early in ulcer history, even when the troublesome element (of digestion) can be diagnosed nothing more than hyperchlorhydria or hypersecretion, but as the disease progresses and motor power lessens either from obstruction, spasm, or myasthenia, constipation increases and is at times the great complaint for which relief is sought. Constipation usually varies with the spells, and during the intermission the bowel may be tolerant, if not normal. Late in the disease the bowels are usually obstinate; so also are the other symptoms. In gall-stones the bowels play a much less important rôle. In jaundice we have the clay stools and at times constipation, but rarely at any stage that obstinate condition so frequent in advanced ulcer.

Loss of Nutrition.—This is often seen in ulcer of the duodenum, more frequently, however, in the later stages. Early, the gain follows rapidly on the path of intermission, or loss and gain may not be marked in degree either way. Simply, if the trouble developed during the period of natural growth, normal gain may never have been realized. Late, the nutrition usually suffers, and at times so profoundly that the patient when he presents himself at the clinic is practically moribund.

In early gall-bladder trouble we rarely find nutrition affected. The attacks are short and widely separated, vomiting infrequent, and if present there is little or no sacrifice of material ingested and, there being no food delay, its nutritive value has not been changed or lessened. A poor state of nutrition is reserved, first, for the common-duct cases; second, those with more or less chronic jaundice

from any cause; third, the chronic sufferers who have developed stomach symptoms through adhesions, ulceration, or constant gall-bladder irritation. Pancreatic infection following this latter class of cases is a potent factor in nutrition.

Ulcer will often be closely simulated by: (1) duct obstruction; (2) some chronic forms of cholecystitis; and (3) gall-stone cases in which one or a few large stones are in a shrunken gall-cyst.

Stomach Contents.—Analysis of the stomach contents has a degree of determining force. In uncomplicated gall-bladder disease the gastric contents will be normal. In ulcer the acidity runs above normal in the larger number of cases, being about that found in peptic ulcer elsewhere. Blood may be found in traces or in large quantities, not constant at all, unless large areas are involved, and obstruction, dilatation, and myasthenia are marked.

CONCLUSION

To sum up, we may say that pain in cholecystitis is sudden and severe, usually has a wide field of radiation, comes with no regularity as to time, is rarely caused by food and as rarely eased by it, nor does the patient often trace his distress to it. There is no stomach history between the short sharp attacks; spasm of the diaphragm with dyspnea is common, vomiting and gas, if present, are so only during the colic, and the relief from eructation and vomiting is not so marked as in ulcer. Nausea and intense retching may be followed by vomiting of a small amount of thin, yellowish, bitter liquid mixed with mucus.

In duodenal ulcer pain comes in periods of attack lasting for days or weeks, is often sudden, may be severe, yet usually not that intense type of pain met in gall-stones, but rather gnawing and burning in character. It may be irregular as to time of the separate attacks, but regular during the period of the stomach disturbance. The pain is clearly related to food, the intensity often modified by kind and quantity taken. Food eases for a time, the pain returning from two to four hours later. Hot drinks, soda, and irrigation give relief. Spasm of the diaphragm is rarely seen except in some cases of perforation.

The chronic gall-stone case, with impacted stone, ulceration, and adhesions, in which no jaundice appears, and the stomach symptoms, as gas, vomiting, burning distress, sour eructation, impaired appetite, and dilatation, predominate, and the pain is moderate and follows food, will too often be diagnosticated ulcer; while the duodenal case, in whose early history we can elicit only irregular attacks of sudden, sharp, intense pain of peritonitis or acute spasm (and with no obstruction or hyperacidity), and in which we do not have gas, vomiting, or sour eructations, will as surely be mistaken for gall-stones.

To the conceits of surgery we shall too often be obliged to leave the differentiation of this class of cases and to its comprehensiveness the surety of relief.

RELATION OF THE MESOCOLIC BAND TO GASTRO-ENTEROSTOMY *

By WILLIAM J. MAYO

Other things being equal, posterior gastrojejunostomy is the operation of choice. This does not mean, however, that the anterior method has become obsolete, but rather that its field of usefulness has become greatly curtailed. All of our earlier operations were made anteriorly, and a number of cases operated upon more than five years ago are to-day in perfect health.

The elimination of the loop has, I believe, been a most important step in advance. The great advantage of the posterior over the anterior method lies in the fact that the anterior requires from 16 to 20 inches of jejunum for the loop around the transverse colon, while no loop at all is necessary in the posterior method.

In the April number of the "Annals of Surgery," 1906, page 537, I called attention to the fact that in the living subject the first portion of the jejunum usually passed from the duodenojejunal angle downward and to the left, and for this reason advised that the jejunum be applied to the posterior wall of the stomach, so as not to disturb this normal relationship, instead of turning the bowel on a short angle to the right, as had been the custom.

There seems to be some difference of opinion as to just what constitutes the "no loop" operation, and particularly as to the frequency with which in the living subject the jejunum passes from its origin to the right. I think that much of the misconception as to the anatomic relationship comes from the variation in degree with which the peritoneal suspensory ligament extends down from the transverse mesocolon upon the upper part of the jejunum. The

* Reprinted from "Annals of Surgery," January, 1908.

ligament of Treitz is an unimportant muscular structure covered by a small peritoneal fold, as in Fig. 10; but this peritoneal reflection



Fig. 10.—Showing small peritoneal fold, with intestine passing to the left. Normal form.

may be of such extent as to project downward several inches, as in Fig. 11.

It can readily be seen that as the intestinal coil is formed this

peritoneal adhesion may extend so far down upon the coil as to reach the jejunum after it has turned to the right, and if the gastro-



Fig. 11.—Showing extensive peritoneal fold which turns the intestine to the right.

jejunostomy is placed at this point, the intestine will be applied to the posterior wall of the stomach, not in the “no loop” position, but

upon a loop of from 4 to 6 inches; a situation which experience has shown to be exceedingly liable to give rise to bile regurgitation such as so frequently occurred in the "loop" operations of the past. The operator would erroneously believe that the jejunum turned to the right and that he had made a no loop operation, while as a matter of fact a loop was present, but more or less concealed in the investing peritoneum. (Fig. 12.)

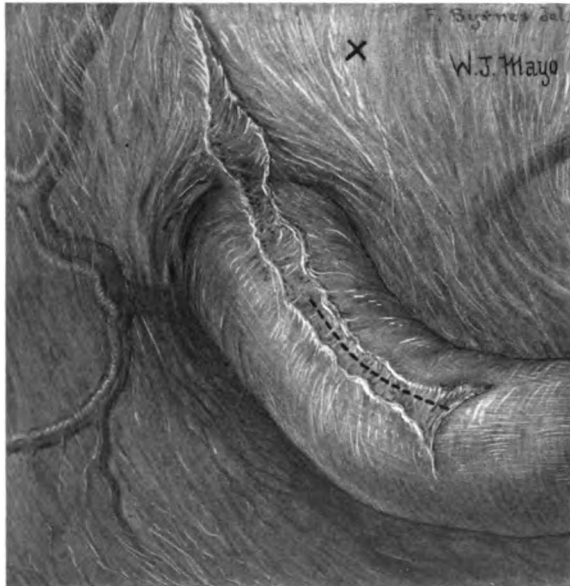


Fig. 12.—Shows the peritoneal fold separated. Dotted line shows proper situation for a no-loop gastro-enterostomy. X marks the point in the transverse mesocolon, where the stomach is to be brought out.

When such peritoneal bands or adhesions exist to any considerable extent they should be trimmed back to expose the origin of the jejunum, which will, in the great majority of cases, now be found to run in the normal direction to the left, and the gastrojejunostomy can be made at the beginning of the jejunum in the area which has been denuded of the adhesions (Fig. 12).

When this peritoneal band is pulled upon, it will be found that it has its origin in the transverse mesocolon close to the left margin

of the branch of the middle colic vessel which is to be seen in the drawings just to the right of the duodenojejunal juncture. The avascular space in the mesocolon lies to the left of this adhesion, and through this space the posterior wall of the stomach should be brought out for operation.

There are several situations in the abdomen where peritoneal bands or adhesions are occasionally to be found. These bands may vary within wide limits, and again be so frequently absent as to lead to the belief, when they are present, that they are pathologic; since disease may produce similar results.

In the fetus the lesser cavity of the peritoneum extends down between the omental fold. Soon after birth obliteration has usually extended as high as the transverse colon, and in the adult the obliteration frequently extends higher, especially along the pyloric half of the stomach, so that posterior adhesions limiting the lesser cavity of the peritoneum may be mistakenly thought to be the result of disease. Peritoneal adhesions of the same character are often found connecting the sigmoid flexure of the colon to the pelvic wall. A very common example is the peritoneal reflection which sometimes joins the gall-bladder on its inner inferior aspect, with the duodenum and transverse colon, greatly resembling adhesions produced by cholecystitis.

A STUDY OF GASTRIC AND DUODENAL ULCERS, WITH ESPECIAL REFERENCE TO THEIR SURGICAL CURE *

By WILLIAM J. MAYO

This paper is limited in its scope to a discussion of gastric and duodenal ulcers with a view to presenting some facts as to their surgical cure. There seems to be much misapprehension in the minds of the profession at large as to just what cases should be subjected to surgical treatment, and at what stage operation is to be recommended, if at all. In the following series the average duration of the pre-operative symptoms was over twelve years, and no patient was operated upon for ulcer until medical treatment had been tried over and over again without securing a permanent cure.

There is no conflict between medicine and surgery in this field, as only the cases that fail to yield to a *reasonable* amount of medical treatment should be considered surgically.

The physician is quite within reason in asking the surgeon as to the ultimate results of the operative treatment of gastric and duodenal ulcers. It is not enough that we show the mortality immediately following operation to be low, and the patient temporarily relieved, but two years of time at least should elapse after operation before the patient can be safely pronounced cured. The answer to the question is, however, not an easy one, as a number of factors must be taken into account.

In the earlier work some of the patients were not relieved because of technical errors which have now been corrected, and especially because gastrojejunostomy was, for a time, looked upon as a "cure all" and applied indiscriminately without regard to local

* Read before the American Surgical Association, May 4, 1908. (Reprinted from "Annals of Surgery," June, 1908.)

conditions. In other instances of apparent failure the diagnosis was questionable, as the evidence that the disease was ulcer depended upon pre-operative clinical data, rather than pathologic findings at the operating table.

It may be said, too, that gastric and duodenal ulcers cannot be separated from their complications, so that no review would be complete on the surgical side without including obstructions, deformities, and limiting adhesions that interfere with the gastric function even after the ulcer itself has healed.

It seems wise at this time, therefore, to present all the cases of ulcer and kindred benign diseases of the stomach and duodenum operated upon by Dr. C. H. Mayo and myself since the first case in 1893, a period of fifteen years, but to confine the special investigation and statistics to the ulcer group.

Total number of operations to May 1, 1908, 827; total number of patients operated upon, 768. Two hundred and twenty-five cases were operated upon for benign lesions other than ulcer and are classified in the following groups:

- I. Adhesions and bands the result of ulcer.
- II. Secondary infectious processes, such as subdiaphragmatic abscess, etc., the result of perforating ulcer.
- III. Cases apparently of inflammatory origin, but in which evidence that the process was ulcer proved insufficient to classify them as such.
- IV. Pyloric obstruction from contracture of the pyloric muscle, valve formation, etc., apparently not due to ulcer.
- V. Bullet and stab wounds, other traumatisms, and foreign bodies.
- VI. Benign tumors, hypertrophic pyloric stenosis, syphilis, and tuberculosis.
- VII. In which the stomach was opened to obtain access to the cardiac orifice for cardiospasm and benign strictures of the esophagus. Gastrostomy, etc.
- VIII. In which the duodenum was opened to obtain access to stones and tumors in the posterior wall of duodenum, papilla, and ampulla of Vater.

IX. Obstructions and ulcerations of the stomach and duodenum caused by gall-stones.

X. Negative explorations of interior of stomach and duodenum.

This leaves 540 cases operated upon for ulcer of the stomach and duodenum.

ACUTE PERFORATIONS

There were 27 patients operated upon for acute perforations. In 5 primary gastrojejunostomy was also done, with two deaths. In 22 closure of the perforation was made with abdominal drainage, and but one of the 18 who recovered required a secondary gastrojejunostomy, the perforation having seemingly put an end to the disease.

Acting upon this observation, I have twice, in chronic gastric ulcer where the conditions were such that I could not excise and where gastrojejunostomy was not indicated, exposed the crater of the ulcer, which in each case was found comparatively small, but surrounded by a mass of indurated and scar tissue. With a sharp knife I cut out the base of the ulcer, thus producing the picture of acute perforation, then closed the defect. Just what the ultimate outcome will be I do not know, but the immediate results have been most favorable.

DEVELOPMENT OF THE SURGICAL TREATMENT OF CHRONIC ULCER

Our experience with the surgical treatment of chronic gastric and duodenal ulcers can be divided into three stages:

First, the period previous to 1900.

Second, the period from 1900 up to and including 1905.

Third, from 1905 to the present time.

First Period.—The surgery of chronic gastric and duodenal ulcers previous to 1900 might be called the surgery of benign obstructions, as the majority of operations were for gross lesions. The relief afforded by these operations was immediate and permanent in all but a few cases where technical failure to secure good gastric drainage was at fault. The operative mortality was about 6 per cent.

Two varieties of operations were employed: Gastrojejunostomy and pyloroplasty. Unfortunately, one-third of our cases subjected to the pyloroplasty of Heinecke-Mikulicz required secondary operation. Then, as now, we generally employed gastrojejunostomy, but made it anteriorly, with the Murphy button. The character of the complications subsequent to this operation varied from the occasional dropping into the stomach of the button to the contraction of the opening due to the traction weight of the attached intestine at the point of anastomosis. Volvulus of the loop and incarceration of the small intestine through the loop, each, however, accounted for the necessity of a secondary operation.

At the meeting of the American Surgical Association, 1902, I reported seven of these mishaps, but in spite of technical errors, operations during this early period were very successful. The Murphy button demonstrated the great possibilities of gastrointestinal surgery and the occasional failure of the button stimulated efforts toward betterment of methods.

We learned by experience that within reasonable limits the greater the obstruction the more certain the cure, and we also learned the value of having the opening in the stomach at the lowest point,* for we noticed that after the button was placed, all of those cases in which the traction weight on the anterior gastric wall caused a funnel to form gave successful results, and, as will be shown later, the majority have remained well up to the present time—from eight to fifteen years.

Second Period.—Stimulated by these early successes, the next six years were marked by the invasion of new fields; we were no longer contented to wait for starvation through obstruction to force operation, but rather attempted to forestall this final stage, and by earlier operation terminate the disability, relieving the patient from the underfeeding and pain which are such marked symptoms of the malady.

The results in this group did not compare favorably with the early period, in which the problem was purely one of mechanics arising from interference with gastric drainage, or with the third

* "Annals of Surgery," August, 1902.

period, in which technical errors had been largely eliminated and a sound pathologic basis substituted for fallacious clinical observations.

The problem was approached with the knowledge gained from the operative treatment of obstruction, but when this was put into actual practice where there was no obstruction, it was very quickly found that the stomach was not a bag emptying itself by gravity, but a muscular organ which always propelled the food toward the pylorus, and that if the pyloric end of the stomach and the upper duodenum were not interfered with mechanically or otherwise by the presence of an ulcer, that the food would not pass out of the gastrojejunostomy opening, but in spite of it would continue through the pylorus. While this position was disputed at the time by eminent authorities, I believe that it is now generally accepted. In some cases, where the ulcer was situated at a considerable distance above the pylorus, a certain amount of benefit did occur, however, by reason of the passive drainage of the irritating gastric secretions through the artificial stoma during the period in which the stomach was fasting and inactive.

It was eventually discovered that ulcers which exist to the left of the pyloric end of the stomach should, if possible, be excised, but if in doing this deformity was created which would interfere with the progress of food, gastrojejunostomy should in addition be performed.

The excision of gastric ulcers was still further stimulated in that a considerable percentage of ulcers later degenerated into cancer. In 180 cases of our own in which part of the stomach was resected, cancer on ulcer base was demonstrated in 54 per cent. Ulcer of the duodenum seldom undergoes malignant metamorphosis, so that this indication for excision does not apply with the same force to duodenal ulcers.

During this second period great efforts were made to improve the technic of gastrojejunostomy. Where pyloric obstruction was present almost any method gave good results, but if no obstruction existed some of the biliary and pancreatic secretions were liable to enter the stomach, and this annoying complication occasionally

led to the necessity for an entero-anastomosis to check the disturbance.

Roux, Doyen and others invented primary operations combining entero-anastomosis in some form with gastrojejunostomy, while von Eiselsberg proposed to obstruct the pylorus artificially, thinking to produce the favorable conditions known to be present in obstructions.

The posterior operation gradually replaced the anterior as the popular method. The loop was eliminated, and we no longer turned the jejunum to the right, but sutured it to the stomach as it runs normally downward and to the left.

We have made over 300 gastrojejunostomies for ulcers of the stomach and duodenum by this particular method with a mortality of less than one per cent., and but three cases have required a secondary operation upon the stomach for any cause.

In all "loop" operations, anterior or posterior, the intestine is applied to the stomach downward and to the right, but in the "no loop" method we found that this sometimes caused angulation, as it turned the jejunum at the duodenojejunal angle rather sharply from its normal position, and occasionally caused chronic bile regurgitation.

The vertical attachment of the jejunum to the stomach as originally practised by Mikulicz with a transverse intestinal incision, and by Czerny with the Murphy button, has been recently revived by Moynihan, who is now using it with the longitudinal intestinal incision.*

Technical errors, however, were not the sole cause of failure to cure. The whole subject was pathologically undeveloped; we did not always know at the operating table whether ulcer was present or not, and we failed to differentiate ulcer from non-operative diseases of the stomach, and occasionally operated upon patients who would have been better treated otherwise. In the beginning we really had little exact knowledge of the living pathology of ulcer except its complications—obstructions, perforation, and hemorrhage. The clinical symptomatology was based upon an erroneous

* "Annals of Surgery," April, 1908.

pathology, teaching that chronic ulcer frequently confined itself to the mucous coat, consequently gastrojejunostomy was often done when no ulcer could be found, under the mistaken idea that an ulcer actually existed, but was hidden in the interior of the stomach, and a number of patients whom the operation had failed to relieve because they did not have gastric or duodenal ulcer were recorded by both physician and surgeon as instances of operative failure to

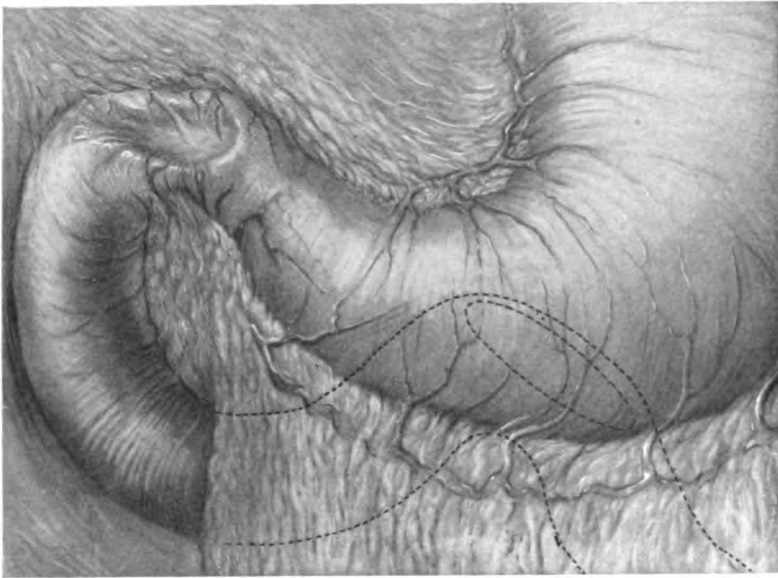


Fig. 13.—Ulcer of the duodenum and gastrojejunostomy after the posterior "no-loop" method. Jejunum applied to the stomach as it normally runs, to the left and downward.

cure, instead of a *mistake in both diagnosis and operation*, which was the fact.

In 14 cases of our own and a number in which the primary operation was done by other surgeons, we have re-operated for trouble of this description and often failed to find any trace of an ulcer; we have, therefore, cut off the gastrojejunostomy and closed both sides, restoring the gastrointestinal canal to its normal continuity.

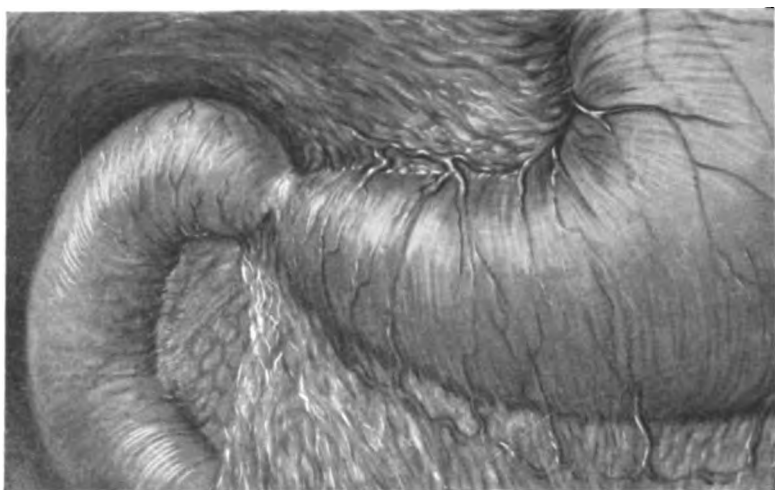


Fig. 14.—Pyloric stricture. Finney's gastroduodenostomy indicated.

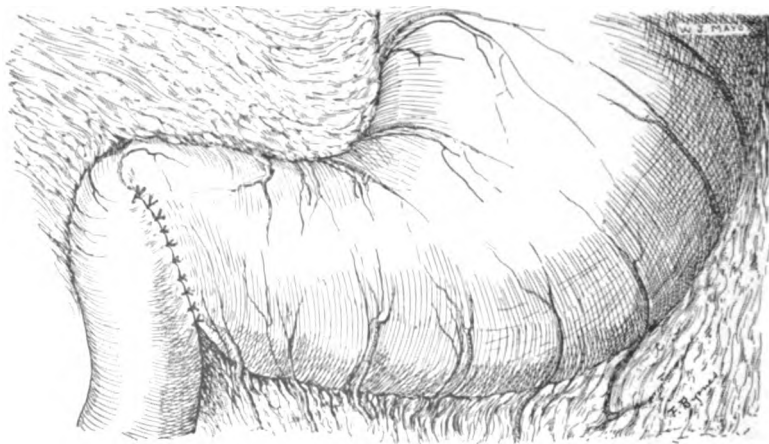


Fig. 15.—Result of Finney operation. (See Fig. 14.)

Strange to say that following this temporary gastrojejunostomy nearly half of the patients were relieved of their original discom-

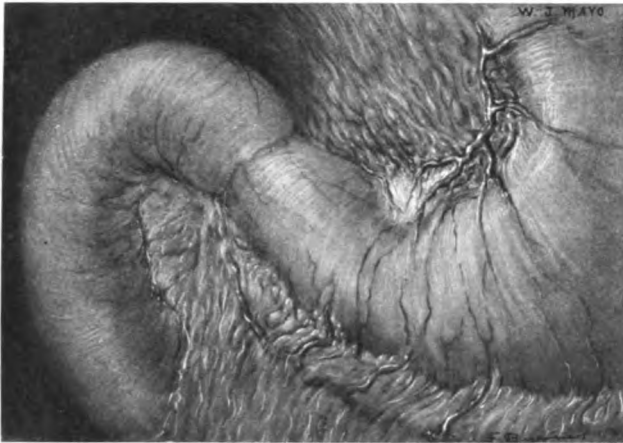


Fig. 16.—Saddle ulcer of the lesser curvature without causing serious obstruction and indicating excision. (See Fig. 17.)

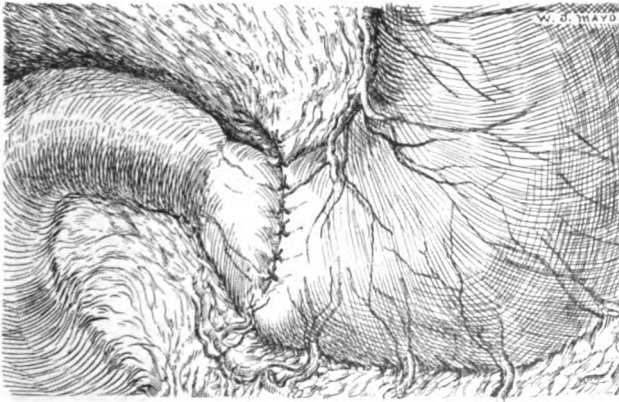


Fig. 17.—Result of excision of saddle ulcer. (See Fig. 16.)

fort, but sufficient time has not elapsed for us to know whether this will be permanent.

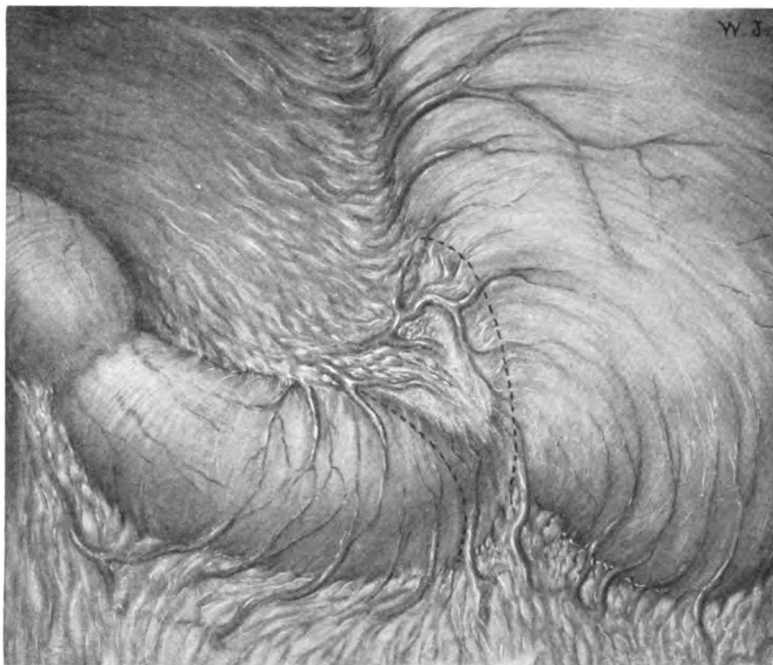


Fig. 18.—Hour-glass stomach. Dotted lines show proposed resection. (See Fig. 19.)

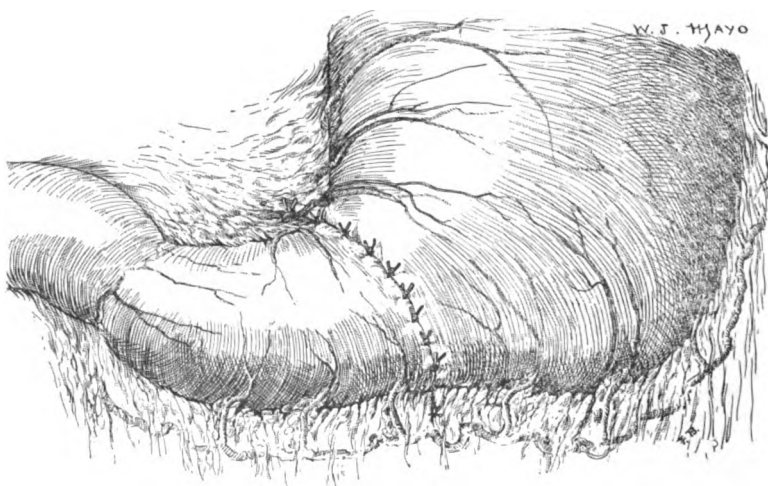


Fig. 19.—Result of resection of the obstructing ulcer in the hour-glass stomach. (See Fig. 18.)



Fig. 20.—Calloused ulcer at pyloric end of stomach. Indicating resection. (See Fig. 21.)



Fig. 21.—Result of Rodman's excision of pyloric end of stomach for calloused ulcer with gastrojejunostomy. (See Fig. 20.)

The Finney operation gave remarkably good ultimate results in pyloric obstructions, but in cases of unhealed ulcers existing proximal to or distal from the parts involved in this operation, less benefit was derived unless the ulcer lay within the zone of the operative field so that it could be coincidentally excised.

The mortality of this second period was not greatly reduced, remaining at about 5 per cent., largely because a number of these patients had complicated operations, and in some instances several operations, which increased the mortality; but in spite of these developmental errors the large majority of true ulcers were relieved or cured, as will be demonstrated later.

Third Period.—The third period covers about two and one-half years. The doubtful cases have been eliminated, and a living pathology established which enabled the surgeon to recognize the ulcer at the operating table. If the ulcer is not actually demonstrated, no gastric operation is undertaken unless necessitated by hemorrhage.

Gastrojejunostomy is still our most valuable operation, especially for duodenal ulcer, which is the lesion in nearly two-thirds of our cases (Fig. 13).

The operation of Finney is chosen for pyloric strictures (Figs. 14 and 15).

Ulcers in the stomach at a distance from the pylorus are excised (Figs. 16 and 17).

If hour-glass contraction is present, the whole diseased area is excised (Figs. 18 and 19). If it is not possible to do this, proximal gastrojejunostomy is performed.

Calloused ulcer of the pyloric end of the stomach indicates the operation of Rodman (Figs. 20 and 21), consisting of resection of the diseased area with closure of the duodenum and independent gastrojejunostomy. (Modified Billroth, No. II, for cancer.)

The mortality of even the more complicated operations does not exceed 3 per cent., while the cures will, I believe, run 95 per cent. or over.

SURGICAL CURES OF GASTRIC AND DUODENAL ULCERS

Three hundred and seventy-nine cases of gastric and duodenal ulcer were operated upon by us previous to June 1, 1906, consisting of 211 males and 168 females, with an operative mortality of 4.8 per cent.

In 64 of these no ulcer was actually demonstrated at the time of operation, the record stating that they were clinical, medical, or mucous ulcers, as they were then called.

In some, slight points of apparent thickening were found, or spots where the mucous membrane did not "seem to glide on the muscular tunic as it should," and this was accepted as evidence, but in our later work actual search of the mucosa for such supposed lesions did not often show their existence.

This brings up the important question: Can *chronic* ulcer exist without visible and pronounced evidence in the walls of the stomach and duodenum? We must admit that this is a rare possibility. We have operated upon a few cases in which we were unable to detect an ulcer even after careful intragastric investigation when the history seemed to demonstrate that an ulcer was present.

Eleven, or 17 per cent. of the 64 patients, required supplementary operations at a later date. In nine, no ulcer was discovered at the second operation, but in two an ulcer was found which had been previously overlooked. It seems fair, therefore, to put all of these 64 cases, excepting the two just mentioned in which the ulcer was shown at the second operation, in a separate classification as questionable. All of these were operated upon in the second period between 1900 and 1906. Since that time no questionable cases have been submitted to operation.

Of this questionable group we have obtained knowledge of 50. Seventeen, or 34 per cent., were cured. Fourteen, or 28 per cent., improved. Sixteen, or 32 per cent., unimproved, and 3, or 6 per cent., are dead, showing cured and improved 62 per cent.

In the 318 cases of actually demonstrated ulcer, we have traced 234. Of these 189, or 80.7 per cent., are cured. Twenty-one, or 9 per cent., improved, 10, or 4.2 per cent., unimproved, and 14, or

6 per cent., have died since the operation from various causes; in only two cases, however, was the cause of death connected with the stomach, showing a total of 89.7 per cent. cured and improved.

In conclusion, let me say that ulcer patients need careful regulation of diet, etc., following operation, and should be under medical supervision until they have made a complete recovery.

HEMORRHAGE FROM THE STOMACH AND DUODENUM *

By WILLIAM J. MAYO

Given a patient who has suffered from gastric distress, acidity, and other evidences of ulcer, and then suffers from repeated hemorrhages shown in the vomitus and in the stool, the diagnostic value of the hemorrhage is very great; but a single hemorrhage from a patient who has not had previous gastric symptoms is probably not due to ulcer.

Hilton Fagge long ago called attention to rupture of the veins about the cardia from cirrhosis of the liver, and also to swallowed blood from hemoptysis, as a frequent cause of supposed gastric hemorrhage. With increasing experience we are less inclined to look either upon hemorrhage as a sure sign of, or upon its absence as contraindicating, the presence of ulcer.

An examination of the gross specimen of the contents of the stomach after the test-meal for blood is important, and sometimes of even greater differential value than the finer laboratory tests, especially as between ulcer and cancer. The delicate tests now used may sometimes give a reaction from blood produced by the slight traumatism inflicted by the introduction of the stomach-tube itself, which an examination of the whole specimen would show to be traumatic.

Visible or occult blood in the stools affords proof as to the fact that there is blood, but it should never be lost sight of that it bears with it no evidence as to its exact gastro-intestinal origin. The patient may have bleeding gums or hemorrhage from some slight abrasion in any part of the many feet of mucous membrane which

* Reprinted from "Surgery, Gynecology and Obstetrics," May, 1908, pages 451-454.

exist between the lips and the anus. If occult blood is found by one chemical test, it must be corroborated by others, as some unsuspected food or drug may give rise to the reaction.

As a matter of fact, hemorrhage from ulcer is by no means of frequent occurrence. The base of the ulcer is clean and free from granulation tissue, so that bleeding may be infrequent. Careful examination of the stool for many days may be necessary to detect its presence; quite contrary to the condition in cancer, where occult blood in the feces will be found in the majority of cases, in this respect resembling the hemorrhage from cancer of the cervix, rectum, bladder, mouth, and other mucous surfaces.

Graham says that "coffee-ground blood and lactic acid in the stomach contents are strong indications of cancer, and that occult blood will usually be found in the feces of these cases, especially if the free hydrochloric acid is reduced or absent."

Copious hemorrhage at frequent intervals is the history of a considerable percentage of ulcers, while continuous small hemorrhages are the rule in cancer, although in some cases continuous loss of small quantities of blood does take place in ulcer, producing a degree of anemia which requires careful differential blood examination to tell from the pernicious type, and occasionally a cancerous erosion of large blood-vessels will cause death from hemorrhage.

Ninety to 96 per cent. of gastric and duodenal hemorrhages cease spontaneously. Fatal hemorrhage occurs in from 4 to 10 per cent., and in 55 per cent. of these the splenic vessel is involved (Brinton).

Eighteen and one-half per cent. of those dying from hemorrhage die so quickly that an operation could not be performed (Savariaud).

Bleeding ulcers can be divided into three groups: First, the acute round peptic ulcer of Cruveilhier. In several cases of this type which we have had an opportunity to examine, where the stomach was opened and the bleeding-point found, the ulcer did not prove to be round, but rather a small fissure which was detected with difficulty.

The second variety is the mucous erosion of Dieulafoy, varying to a greater or less extent in size, and in which the affected mucosa

"weeps" blood. Like the acute peptic ulcer, mucous erosion is probably infective or toxic in origin. Fig. 22 is a photograph of the gastric mucous membrane in a fatal case of the Dieulafoy ulcer which came under our observation.

In the older literature on this subject we find constant reference to the peculiar frequency of gastric hemorrhages in young women, which are of doubtful origin, but supposed to be due to ulcer. Hale White described some cases of hemorrhage of the stomach in

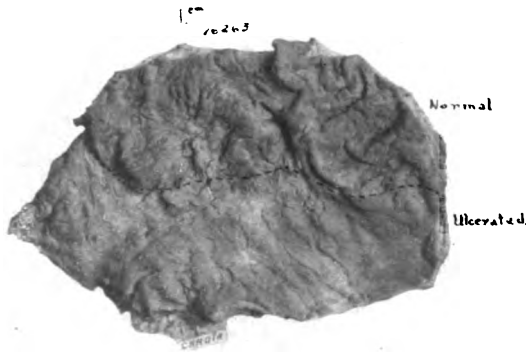


Fig. 22.—Photograph of large mucous erosion of stomach.

young women which belong to this category and which he calls *gastrostaxis*.

Acute peptic ulcer and mucous erosions are rare conditions. Generally speaking, hemorrhage from these acute processes belongs to the domain of internal medicine rather than that of surgery, and a large percentage of these patients recover spontaneously.

The third variety, that of hemorrhage from a chronic ulcer, is surgical, although not necessarily operative during the acute stage (Rodman). The whole thing turns on the history of the patient. If the patient gives an ulcer history extending over a period of time

before the hemorrhage, this at once differentiates it sharply from all the non-surgical hemorrhages of the stomach, and, in the large majority of cases, from these little-understood processes which are included with acute peptic ulcers and mucous erosions.

More than 90 per cent. of hemorrhages from the stomach are from chronic ulcers with a well-marked ulcer history. In the greater

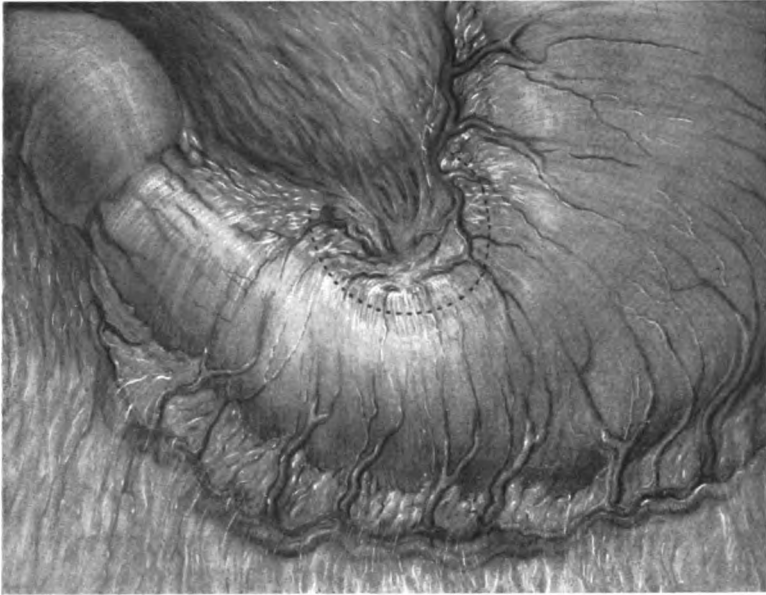


Fig. 23.—Saddle ulcer of lesser curvature involving anterior and posterior surfaces, showing varicose blood-vessels in the margins of the ulcer. Anterior margin of excision outlined by dotted lines.

number the condition would have warranted operation independent of the hemorrhage. So long as the surgical indication furnished by the hemorrhage is backed by the ulcer history, we know that we have a definite local lesion to deal with, and that the patient will be relieved not only of the hemorrhages, but also from the chronic disability of the primary disease.

I do not mean to say that operation should not be practised where there is hemorrhage from the stomach without previous history of ulcer, but rather that in such cases the burden of proof must show why an operation should be performed; while in hemorrhage from chronic ulcer, the burden of proof must show why an operation should not be performed.

As to the surgical treatment of hemorrhage, there is some difference of opinion. Many surgeons believe that gastrojejunostomy

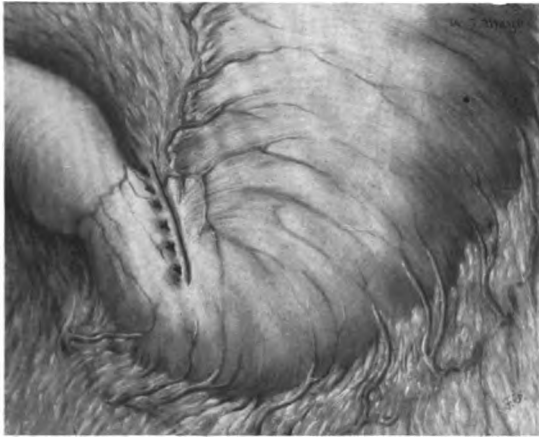


Fig. 24.—Showing closure of stomach defect after excision of ulcer in such manner as to enlarge rather than diminish the lumen. Anterior half of suture line shown.

is efficient as a curative agent without direct attack upon the bleeding vessel. While we would agree with this opinion as regards small and moderate hemorrhages, in cases of severe bleeding from prepyloric and duodenal ulcers, gastrojejunostomy may prove inefficient. We had one patient die from hemorrhage twelve days after gastrojejunostomy; and postmortem revealed the open vessel in the margin of the ulcer. A second case of the same nature required re-operation with direct attack upon the bleeding vessel in the ulcer six days after gastrojejunostomy. A third suffered

repeated hemorrhage following, and two years later the ulcer was excised with cure. Many such experiences are recorded in literature.

Gastrojejunostomy after the posterior "no loop" method gives ideal results if there is, actually or potentially, interference with the progress of food. When the ulcer is some distance above the pylorus, permitting of ready egress by the normal outlet, gastrojejunostomy is of less value.

There has been considerable discussion as to whether the bowel in gastrojejunostomy should be turned to the right or allowed to remain in its normal position to the left. Regarding this point, I can only say that in 292 cases of "no loop" gastrojejunostomies in which the intestine was sutured as it runs to the left, we had but three deaths and two re-operations; both of the latter from adhesions which were corrected at the second operation by fastening the bowel to the left beyond the gastrojejunostomy to prevent angulation.

In connection with the gastrojejunostomy, if an ulcer exists in the stomach it should be excised if possible. When this is not feasible the main blood-vessels leading into it should be ligated and the peritoneum and muscular coats drawn over it. Excision is the better procedure, however, as it gets rid of the disease and prevents a possible secondary cancerous degeneration (Figs. 23 and 24).

Bleeding ulcers which lie a considerable distance above the pylorus should be excised. In extensive ulcers, such as the hour-glass variety, this may amount to resection in continuity. In doing this resection, much deformity may result from the plastic closure of the gap produced by removal of the ulcer, and should the deformity interfere materially with drainage through the pylorus, gastrojejunostomy in addition may be required. In hemorrhage from duodenal ulcer, ligation of the blood-vessels and closure of the outer coats over the indurated area, with gastrojejunostomy, will be found efficient.

In the majority of bleeding ulcers, of both the stomach and duo-

denum, the blood-vessels leading into them are varicosed. (See Fig. 23.)

For severe hemorrhage from the stomach, in those cases in which no ulcer can be located from the exterior, we have followed a modification of the Andrews-Moullin method, opening the anterior wall of the stomach by a longitudinal incision, and by counter-pressure causing successive areas of the mucous membrane to present itself at the opening until the bleeding-point was detected. With chromic catgut on a small curved needle, the hemorrhagic area is sutured from the mucous side. Over this, on the peritoneal side, a few linen sutures are introduced for protection, after which the working incision into the stomach is closed in the usual manner.

CHRONIC ULCER OF THE STOMACH AND DUODENUM *

By WILLIAM J. MAYO

Embryologically the stomach and first four inches of the duodenum have their origin from some part of the foregut, thus explaining the close association which exists between these organs in both function and pathology.

The mucous membrane of the duodenum, above the opening of the duct of Santorini and the common duct, is thin and of a smooth, velvety character. Beyond this point it is much thicker, forming the *valvula conniventes* characteristic of the assimilating portion of the intestinal tract.

The liver and pancreas also have their embryologic origin from the lower end of the foregut. The liver begins in the third week of fetal life as a diverticulum into the anterior mesogastrium, and the pancreas as a similar process in the posterior mesogastrium during the fourth week.

All of these organs have to do with the preparation of food for absorption, but the assimilation itself takes place in the derivatives of the midgut, between the opening of the common duct and the splenic flexure of the colon. This latter point marks the beginning of that part of the large bowel which has its origin in the primitive hindgut, and has storage function.

Under normal conditions the stomach acts as a temporary storehouse for food, enabling its possessor rapidly to place in this receptacle a sufficient quantity of material for the slower process of digestion. The varying temperature of the ingesta is equalized,

* Read before the Detroit, Michigan, Medical Society, Feb. 3, 1908, and published simultaneously with the "Detroit Medical Journal." (Reprinted from "The St. Paul Medical Journal," June, 1908.)

and with a weak solution of hydrochloric acid and pepsin the food is macerated and ground into a harmonious whole.

The five-sixths of the stomach lying to the left is concerned in storage and maceration; the one-sixth lying to the right, and consisting of the pyloric end, carries on the grinding process.

For some little time after ingestion there is comparatively little motor action in the stomach, the food forming a composite mass, its outer surface being acted upon by the rapidly secreting hydrochloric acid and pepsin, while in the center the alkaline salivary secretions are still at work. After about thirty minutes the food begins to pass into the pyloric end of the stomach and the process of grinding actually begins.

When a certain stage of digestion is complete the pylorus relaxes, and by a series of gastric contractions the acid chyme is ejected into the duodenum, where it is neutralized by the alkalinity of the biliary and pancreatic secretions. The control of the pyloric apparatus, however, is vested normally not in the stomach, but to a large extent in the upper duodenum, and depends upon the acidity of the duodenal contents and the rapidity with which it is rendered alkaline.

These digestive processes are the result of chemical stimulation rather than nerve force. The central nervous system, through the sight, taste, and smell of food, and the sense of repletion which follows a full meal, has some control over the storage function of the stomach, and in conjunction with the sympathetic nervous system, through the plexuses of Meissner and Auerbach, exercises some feeble influence over the intestinal tract. It is, however, not the dominating agent from the beginning of the pyloric end of the stomach to the splenic flexure of the colon, although it gradually exerts its authority from this point on to gain complete control of the rectum.

While normally the acidity of the upper duodenum regulates the output through the pylorus, under pathologic conditions this control may be exercised by the derivatives of the mid-gut, giving rise to pyloric spasm and other gastric disturbances which have often masqueraded as gastric and duodenal ulcer; for example, the

chronic gastric distress due to gall-stones, appendicitis, tuberculosis of the cecum, and other diseases of the digestive tract.

It accounts also for the diarrhea of achylia, in which the absence of hydrochloric acid leaves the pylorus relaxed and permits the unprepared food to escape so rapidly into the small intestine that it is eliminated as loosely formed undigested stools.

This superficial account of the physiology of digestion brings out the paramount influence of hydrochloric acid and introduces it as the *first* and most important factor in that form of perverted function which results in ulcer.

The *second* factor in ulcer formation is the traumatism inflicted in the grinding pyloric end of the stomach, and that portion of the mucous membrane of the duodenum which receives the physical impact of the acid chyme as it is ejected through the pylorus. Nine-tenths of all ulcers which exist in the stomach proper are in the pyloric end, and at least one-half of all gastric and duodenal ulcers are situated in the upper duodenum.

The *third* essential factor is of a general character, and for want of a better term may be called anemia, meaning that the local resistance, which should be manifested by the nutrition of the patient, for some reason fails.

Local changes in the blood-vessels through thrombosis and embolism, or through perverted nerve influence, have proved a somewhat popular but inadequate explanation of this failure. The protection to the mucous membrane which prevents self-digestion lies within the secretion of the mucous membrane itself and is associated with its blood-supply.

When ulcer has once formed, it has a tendency to penetrate into the muscular coat and is periodically irritated by the physiologic action of the muscles, and by the introduction of food particles into its depths, giving rise to the pain which is so characteristic of the disease. There is induration, and the extent of the disease may be considerable, showing cicatrization in some part of its area. Chronic ulcer in the large majority of cases is single, although it frequently happens that directly opposite the primary ulcer there will be an abrasion of the mucous membrane, sometimes amounting

to a second ulcer, which we have described as a *contact* ulcer. Sometimes chronic ulcers of the stomach are multiple, and occasionally there exists a separate ulcer of the duodenum and stomach.

Ulcers are usually situated near the lesser curvature, often projecting down upon the anterior and posterior walls like saddle-bags. Ulcers of the duodenum are usually single, and to be found within three-fourths of an inch of the pylorus in the large majority of cases, extending up to the duodenal face of the pyloric ring.

The base of the ulcer is clean, of a whitish color, the surrounding mucous membrane being slightly beveled on the distal surface, and very slightly undermined on the proximal.

Chronic ulcer is essentially a disease of adult life. It occurs in the stomach with equal frequency in both sexes, but in the duodenum more than three-fourths are in males.

The progress of chronic ulcer depends upon many factors. Of these location is perhaps the most important.

Ulcers of the pyloric end of the stomach and first portion of the duodenum usually interfere with motility, and often introduce mechanical difficulties in the process of healing, giving rise to obstruction and retention of food. Large ulcers in the body of the stomach may cause hour-glass contraction; no less than two or three or more cicatricial bands, possibly, being found constricting the gastric lumen and separating its cavity into loculi.

The average history of the patients with chronic ulcer upon whom we have operated show that the disease has existed for years. The periodicity of the attack is as well marked as are the attacks of appendicitis or gall-stone disease, the only difference being that in the early history the exacerbations are to be measured by days and weeks, and the intervals by months or years of comparative freedom. These prolonged periods of relief encourage an erroneous view as to the curability of the disease.

In the course of time the attacks become more frequent, and finally the patient arrives at the stage of mechanical obstruction through stenosis, deformity, or adhesions; or, perforation and hemorrhage precipitate an unfortunate ending.

Diagnosis.—The most valuable means of diagnosis lies in the

history of the patient. Attacks of digestive disturbance extending, as a rule, over years of time, and accompanied by excessive acid, pain, and hemorrhage, and in the later stages interference with the progress of food, are the important points to which our attention should be directed.

Acidity.—At some time in the history of all ulcers the gastric secretions show an excess of hydrochloric acid. By laboratory tests this acidity may not be so high as in the hyperchlorhydria of the neurotic state. However, it is not only a question of quality but also of quantity. The excess of acid secretions will often be regurgitated by the patient, not only during the period of digestion, with food, but also from a stomach empty of food, at a time when it should be free of acids. The patient who gives a history of at some time in the night regurgitating a mouthful or two of sour, burning fluid from the fasting stomach, will almost always be found to have an ulcer. This acidity may be so great that the acid eructations may affect the teeth, and they are often found to be greatly shortened from this cause.

During this period the patients get “food-ease,” and will take into the stomach a small quantity of nourishment or bland liquid to dilute the acid secretions. Frequently when they go to bed they take with them some diluent drink and light food to be taken in the night to relieve the distress and burning in the stomach. Ulcer victims starve themselves, however, because they have found by experience that if any considerable quantity of food is taken, the temporary relief obtained by dilution is quickly lost in the stimulation of fresh gastric secretion by the food itself. The large majority of patients take bicarbonate of soda to temporarily reduce the acidity. In the later stages, when obstruction with stagnation and retention of food becomes a prominent symptom, acidity is less marked, but then there may be organic acids, such as lactic and butyric, present.

Billings lays stress in the diagnosis of ulcer upon the finding of free hydrochloric acid in a fasting stomach, and a few leukocytes often partially digested.

Pain.—Pain is a most prominent symptom of ulcer, and in the

height of the attack it is seldom absent. In ulcer of the stomach its area of greatest acuteness usually lies from the median line to the left; in duodenal ulcer, from the median line to the right. In some cases the pain passes through to the back, but we have not found that this is as characteristic as we were led to believe by statements of the clinicians of twenty years ago. The pain varies from a sense of burning to that of deep boring distress. To prevent this pain the patient continuously underfeeds, using those varieties of food which he has found to require but little gastric digestion.

Hemorrhage.—Of all the positive symptoms of gastric ulcer, the presence of blood may be the most misleading. In comparatively few instances will the hemorrhage be characteristic. Given a patient who has suffered from gastric distress, acidity and other evidences of ulcer, and who then suffers from repeated hemorrhages shown in the vomitus and in the stools, the diagnostic value is great. But a single large hemorrhage from a patient who has not had previous gastric symptoms is more likely to be the result of cirrhosis of the liver, or some other disease rather than ulcer.

We have learned by experience that the delicate tests now used for the determination of blood in the gastric contents will sometimes show evidences due to the slight traumatism caused by the use of the stomach-tube.

Much may be learned by the examination of the gross specimen obtained by the stomach-tube after the test-meal. The appearance and smell are often characteristic as contrasted with the combination of coffee-ground blood with lactic acid which is peculiar to cancer.

Visible blood in the stool, unless in considerable quantities and of a tarry nature, must be viewed with caution. Occult blood in the stool affords valuable evidence as to the fact that it is blood, but it should never be lost sight of that it bears with it no indication as to its source. The patient may have bleeding gums, hemorrhoids, or slight abrasion in some part of the many feet of mucous membrane which exists between the lips and the anus. If occult blood is found by one chemical test, it must be corroborated by others, as some unsuspected foods or drugs may give rise to error.

As a matter of fact, hemorrhage from ulcer is by no means of frequent occurrence. The base of the ulcer is clean and free from granulation tissue, so that bleeding may be slight and infrequent. Careful examination of the stools for many days may be necessary to detect its presence; quite contrary to the condition in cancer, where occult blood in the feces will be found almost continuously.

Nausea and Vomiting.—Regurgitation of acid gastric secretion from a fasting stomach has great significance, but vomiting of food, unless there is obstruction, is rather infrequent, although it would readily occur if the patient were to eat freely; but that is just what he does not do. The vomiting of food immediately after taking a meal, especially if it comes up without excessive acid, is usually due to gastric neurosis or some other disorder.

Gas.—The complaint of “gas upon the stomach” is a nearly constant symptom. The patient eructates this gas, which has a sour, bitter taste. This symptom is common to a variety of ailments, however, such as gall-stones and the neurotic state.

Examinations of the blood, urine, etc., have no special value, except as indicating the general condition of the patient, and as much can be said of the various special tests, such as salol, etc.

Up to the present time the gastroscope and gastradiaphonoscope have not secured a recognized position in diagnosis.

Chronic ulcer sooner or later involves the peritoneum. Local peritonitis over the seat of the ulcer, especially about the pyloric end of the stomach and duodenum, is not infrequent, and in many cases *chronic perforation* occurs with slight leakage, more or less protected by advance exudate, giving rise to recurring attacks of regional peritonitis, causing most severe symptoms often lasting several days at a time.

Protected perforations cause the adhesions and peritoneal bands which are found about ulcers in the pyloric end of the stomach and upper duodenum; their situation under the liver and the proximity of the lesser and greater omenta favor ready adhesive closure. Anterior ulcers in the body of the stomach acutely perforate without advance protection in relatively a much larger percentage of

cases, on account of the lack of such good mechanical surroundings, while posterior ulcers are more often protected.

Obstruction.—Ulcers in the pyloric end of the stomach and in the first two inches of the duodenum are potentially obstructive even though there may be no narrowing of the lumen. The local swelling and irritation, caused by infiltration of inflammatory products, interferes with the normal motility, and a certain amount of delay in the progress of food is the result.

Permanent narrowing of the lumen gives rise to obstruction, causing symptoms varying in degree. The gastric muscle hypertrophies sufficiently to compensate, but this compensation is usually irregular, and motor insufficiency and dilatation, alternating with compensation, is the consequence.

The outline of the normal stomach should not descend below the umbilicus. For determining stomach outlines, air dilatation, using the stomach-tube and an ordinary Davidson's syringe for inflation, is quite satisfactory.

If the stomach is prolapsed, the lesser curvature descends from its position under the free border of the ribs to correspond with the extent of the descent of the greater curvature.

Sudden distention of the stomach with tartaric acid and bicarbonate of sodium can be used to show the outlines, and will serve also to indicate points of pain, local tenderness, and spasm, and in quick differential diagnosis is most valuable. For ordinary purposes air distention is preferable, as with it there is less danger of causing perforation at some point in the gastric walls weakened by disease.

Food particles found in the stomach at the expiration of seven hours after a meal indicates obstruction. A good way of determining mechanical obstruction is to have the patient take a full meal in the evening, and then use the tube in the morning on a fasting stomach, to ascertain if it still contains food remnants.

Tumor.—In a certain percentage of chronic ulcers a tumor can be felt. Many patients have been consigned to death because the ulcer tumefaction was supposed to be cancer and, therefore, hopeless.

The differential diagnosis between ulcer of the stomach and duodenum can usually be made. The location of the pain to the right of the median line, the food distress coming on several hours after a meal, etc., are important symptoms of a duodenum location.

Surgical Indications.—A considerable percentage of chronic ulcers eventually heal without producing such a degree of obstruction as to cause death from starvation. Death results directly from acute perforation and hemorrhage in but a small percentage of cases, but indirectly from conditions caused by the disease, the death-rate is not less than 25 per cent., probably more, while secondary cancerous degeneration is not infrequent. Fifty-four per cent. of 172 cancers of the stomach we have submitted to resection had origin in ulcer.

The large majority of patients who come for surgical relief do so to cut short suffering, underfeeding, and disability; the operation being done as a matter of expediency with a view to restoring to the patient his full working capacity.

Gastric Ulcer.—For large, thick, indurated ulcers of the stomach, especially if there be no obstruction, direct excision with secondary gastrojejunostomy, if necessary, supplies the indication. The excision disposes of a constant source of distress and a latent possibility of cancer.

Hour-glass stomach may be treated by plastic operation or proximal gastrojejunostomy. Personally, we prefer resection of the diseased area, with or without gastrojejunostomy.

For ulcers in the pyloric end, with more or less obstruction, good results are obtained from gastrojejunostomy.

Ulcer of the duodenum rarely becomes malignant, but does interfere with the progress of the food, so that gastrojejunostomy is the operation of choice, supplemented in special instances by excision.

CANCER OF THE STOMACH *

By CHRISTOPHER GRAHAM

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The fundamental factor in the etiology of cancer still eludes the careful investigator, is still a mystery. A fuller knowledge of the essence of life seems essential before we can read its inner pathology. However, with an army of enthusiastic and patient workers in the field, and with ever-increasing facilities, we should take courage. And, too, when we consider the yield of knowledge in other fields long resistant we are not without hope that in time this great mystery may also be solved, and dread cancer will be a matter of history.

Much practical knowledge concerning cancer of the stomach has been gained from clinical and surgical methods, and much has been achieved through laboratory research. Some of the predisposing conditions are so clearly outlined that even now we can point out radical lines of treatment and may attack the disease in the precancerous state, thus circumventing the dread scourge and, through prevention, reach the heights of modern medicine.

Back in the late nineties we were impressed by the long precancerous histories of many of our patients. This precancerous history was that of ulcer, and often covered a period of years (typically chronic ulcer), until finally malignancy developed, symptoms changed, and signal danger approached. The percentage in long histories has not held so high of late as in earlier years, though it still averages about 50. But what has better strengthened our position that ulcer is the great and fertile soil of cancer have been the pathologic findings during the past four or five years. However

* Read Aug. 5, 1908, at the centennial meeting of the Cortland County Medical Society at Homer, N. Y. (Reprinted from "The Boston Medical and Surgical Journal," vol. clix, No. 20, pp. 635-639, Nov. 12, 1908.)

satisfactory a long history may be, we have demonstrated that it is not necessary in order to establish the fact that ulcer precedes cancer. Indeed, some of our shortest histories have proved to be those where cancer has been implanted on a previously non-malignant ulcer base. Proof of this fact is obvious. We know that ulcers are often latent for years and are first recognized when bleeding, perforation, obstruction, or cancerous degeneration becomes manifest. When cancer attacks one of these latent ulcers, great inroads may be made before symptoms other than the loss of flesh and strength are felt. Sudden obstruction from new growths and paralysis of the stomach wall may develop, motor power disappear, rapid loss of flesh follow, and death result within a few weeks. These cases have but a short manifest history, but the real condition remains the same, and the precancerous soil may have existed for months or years.

In all the partial resections of the stomach made for cancer and microscopically examined during the years 1906-07, and until June, 1908, in St. Mary's Hospital, we have been able to demonstrate a precancerous or non-malignant ulcer state in 62 per cent. of the cases. Some of these have long, some short, histories. Among the long histories some can, others cannot, be demonstrated positively as cancer on ulcer, but the period of complaint argues against cancer being present during the whole term of illness.

Before passing to the general symptoms referable to the stomach, I desire to point out and to emphasize the diagnostic significance of the picture of carcinoma of the stomach as seen in the faces of such patients. The face of a patient suffering from cancer of the stomach has certain morbid characteristics. Pallor is often most noticeable about the eyes, nose, and mouth. Wasting, too, shows here, giving a pinched, wrinkled look. The expression is one of stolidity; there is intense conviction of impending danger, and while the patient is intent, as though eager, to read your opinion, the expression is not so much pained as hopeless, calm, and dejected. One may often diagnose cancer of the stomach with reasonable certainty by a glance at the face of the sufferer.

When cancer has once fastened itself upon the stomach, the

course is, as a rule, steadily and surely downward, with rare intervals of freedom from its ravages. The patient loses weight and strength more rapidly than is consistent with lessened appetite; a weakness, loss of desire to do active work, and a feeling of weariness control. Anemia usually develops rapidly. There is a dull, sickening, indescribable pain; or perhaps only a strange distress which is not always closely related to food, is often continuous, and with it a mental depression and consciousness of pending evil. This mental attitude seems to be the special factor which gives to the faces that expression which marks the sufferer with malignant trouble and points out the diagnosis. This factor, coupled with languor and emaciation, leaves but few other diseases to be considered.

In eliciting the history of gastric cancer we find three types. First, those with a long series of repeated attacks which are clearly those of ulcer, the so-called "precancerous state." This is the typical chronic ulcer period. Second, those in which the initial symptoms were more or less severe, but where months or years of quiet intervened before the malignant symptoms appeared. Third, those in which the acute symptoms suddenly attack the patient in the midst of apparent perfect health.

In the first and second types the precancerous history is that of ulcer; that the precursor in the third type is very often ulcer is being determined through surgery and skilful pathologic technic. In this latter group it is more than probable that the early history has been overlooked, or, because of the present increased distress, the patient thinks that the earlier disturbance is not worth considering. From conclusions based on the many histories taken at our clinic, we would distinguish four stages in gastric ulcer development, and would expect cancer when it did develop to appear in the third or fourth stage, or often to be the fourth stage,

In the first stage of ulcer the patient has an unusually good appetite, with nutrition at par or even excessive; pain two to five hours after meals, when the stomach is empty or emptying itself; the heartier the meal, the longer and more complete is the sense of stomach satisfaction (over-active digestion); perhaps some

gas and sour eructations; occasional vomiting of small amounts of sour, bitter liquid; excess of hydrochloric acid; stomach normal as to position and size. These patients present themselves to be relieved of pain, which they say comes on after meals, but which in reality is pre-meal pain.

The second stage, we may say, begins some months later, following several intermissions with recurrences, each recurrence increasing more or less in severity. The appetite is good, though perhaps not above normal; less satisfaction follows the hearty meal, pain is severe and comes sooner after taking food. Distress or discomfort may be present even when so-called "pain" is absent; gas is usually complained of; sour eructations are common; vomiting of sour, bitter, acrid fluid at times mixed with food is frequent. A sense of relief follows vomiting for a greater or less period. Loss of flesh is noted during the attack, from either voluntary or prescribed dieting, though rapid gain takes place during the intermissions. There is, perhaps, some dilatation, and acidity is high or normal. During the third stage a desire for food may remain; the desire may be fair or decreasing, but the patient will be afraid to eat because of the distress—pain, gas, vomiting, sour eructations, bloating or sour burning stomach—which may follow. There will be but a short period of food relief. Obstructive symptoms, loss of flesh, and even cachexia may be present. Constipation, marked in all stages, is usually obstinate here. The stomach may be dilated and prolapsed; hydrochloric acid normal, lessened, or even absent. Blood may be found during any stage at a test-meal, but more frequently during this stage than previously because, other conditions being equal, the chemical and mechanical powers of the stomach are such that blood destruction (digestion) is retarded.

It is extremely difficult to mark the distinctive period of the transition of the third stage, which is ulcer, into the fourth stage, which may be cancer, so imperceptibly does the change take place.

Some patients are weak, emaciated, and even cachectic, with ulcer the only lesion, (1) if the motor power of the stomach be greatly interfered with, or (2) if the lesion is large and the destruction

great even in the presence of mild obstruction. Here a transition may begin, and although all possible diagnostic means and precautions are taken, a differentiation cannot always be made before wide-spread degeneration removes all hope of cure. But when the clinician is awakened to his important task, he will at least reach the point of honest suspicion and call surgery to his aid. Many times one does find symptoms that offer a basis for differentiation. Pyrosis increases in amount, but is less acute; or, rather, not a pyrosis, but an irregular regurgitation of a less acid fluid. As in ulcer, on stooping, or during the night, fluid which has more or less acidity pours from the stomach and may awaken the patient. This regurgitation is more copious, but usually much less acid, than in ulcer. Gas and bloating with a distended discomfort increase. Nausea and vomiting are more often excited by liquid food. Appetite may persist quite to the end, but, as a rule, it gradually lessens, until finally the patient turns from food with distaste. Nervousness and languor are combined; weakness and faintness creep on; the patient's ability to exert himself decreases rapidly; anemia may come speedily and the flesh waste decidedly. A languid air, a paleness about the eyes, nose, and mouth, associated with a pinched expression (a toxemic look), are common. All these conditions point directly to a transition. The character of the pain changes; it is dull, sickening, more wearing, more continuous, and not so regular in the recurrence of severer pain. The severer attacks come at unexpected times, sooner after food, as a rule, and are not so acute. There is more relief from eructations of gas and vomiting because the depression is deeper. The pain is more diffuse and not so often eased by pressure or position.

Localization of pain, though not always definite in ulcer, is much less so in cancer. As in ulcer, if perforation has taken place, there may be a wide field of radiation, otherwise the epigastrium is the seat of pain. As cancer progresses, diffuseness of pain increases. The diagnosis must, however, be made in the absence of pain. Tenderness is also frequently absent.

Vomiting, always a prominent symptom, usually intensifies as malignancy creeps on. It becomes more irregular, longer between attacks, and is more copious unless there be contraction from diffuse

infiltration. The vomitus is rancid, often acid and obnoxious, foul. All of these symptoms vary in intensity, according to obstruction and destruction, but the chief characteristic of cancer vomiting is that food taken into the stomach several hours or even days before, returns poorly macerated and with undigested masses in it, and this even when pyloric obstruction is not marked (cancer paralysis).

Vomiting is, as a rule, accompanied with less retching in cancer than in ulcer; blood is more frequently seen, while bile is a rarer accompaniment. If there has been a long period between the ulcer symptoms and the recent cancerous change (Type 2), the diagnosis is usually easier because of the constancy, the rapid approach, and marked character of the symptoms. There may be a short but persistent period of flatulency, bloating, lessened appetite, and loss of flesh; then, as is so often marked in Type 3, the sudden burst of malignancy that clinicians say attacks the patient in the height of good health. In these two types we most often find tumor, and in many other respects they are so closely similar that we should be led to consider them counterparts, the early symptoms in the one being overlooked or forgotten by the otherwise healthy individual. Motor power lessens rapidly as cancer progresses, and if the pyloric obstruction is acute and the other symptoms intense, dilatation advances rapidly. Organic acids increase, hydrochloric acid decreases and blood is more often and more easily detected. Finally, it is the composite pathologic picture that the patient presents at the clinic quite as often as the symptoms he urges upon you that fixes the period when the benign has yielded to the malignant condition.

When we reach the undoubted fourth stage (cancerous), the whole picture intensifies. The patient's appetite is poor or absent; even the smell of food may be repulsive. Meats and fats are especially avoided. Emaciation follows rapidly, often faster than can be accounted for by loss of appetite (toxic or perhaps food delay). Strength fails rapidly, languor is intense, and the patient exerts himself with difficulty. The anemic-cachectic condition develops more and more clearly; the body becomes emaciated,

the skin dry, wrinkled, and at times lemon-yellow. Pain increases and is more constant, boring, and undermining; it is less acute, but more sickening. Food, if tolerated at all, almost immediately increases the pain. There is frequent vomiting of quantities of poorly macerated and undigested food, rancid and offensive, and of coffee-ground color. Blood is more constant and more easily detected because of the further decreased or absent motor power; sour stomach, eructations, and gas become distressing. Obstinate constipation, mental depression, extreme languor, cachexia, prolapse, dilatation, tumor, lactic acid fermentation, absence of hydrochloric acid—when these conditions prevail, the diagnosis can scarcely remain doubtful.

The picture of cancer where no obtainable precancerous symptoms are elicited, or where a long period has elapsed since symptoms are recalled, is closely that of the latest stage of those with long-preceding ulcer history, except there is usually less acute pain, or none. Tenderness is more often absent, tumor oftener present, depression and weariness more marked, and the general downward course more violent. These are the cases of whom you say, when they enter the office, "This is cancer of the stomach, and tumor will be found." Here one must be prepared to make a diagnosis in the presence of few symptoms, the facies and the general pathologic picture presented by the patient bearing out the meager clinical findings.

Differential Diagnosis.—This is a broad and difficult field to cover, and too often we find that we are not within the limits of precision. I shall consider but two small groups of diseases, one non-surgical and the other surgical.

(I) Of the non-surgical diseases, syphilis, tuberculosis, Bright's disease, and pernicious anemia only will be briefly discussed. Syphilis, when it attacks the liver or stomach, may closely simulate ulcer or gall-stones, and when quite advanced, the pain, cachexia, and vomiting may lead to a strong suspicion of cancer of the stomach. The history of specific infection, the sudden attacks of pain and vomiting (crises), their almost abrupt cessation after a more or less prolonged period, together with shooting pains of a general

character, cause the diagnostician to hesitate. Anti-syphilitic treatment often aids to clear up the diagnosis.

Many patients with tuberculosis will present themselves with a diagnosis of stomach trouble, not a few of them fearing cancer. Anorexia, food pain, vomiting, emaciation, cachexia are present; hydrochloric acid may be absent. A careful examination reveals irregular fever, cough, bacilli, lung complications or other tubercular foci, and the clinician should not remain long in doubt concerning the correct diagnosis.

Bright's disease will often confuse the physician. Loss of appetite, emaciation, anemia, vomiting, and stomach analysis will closely follow the cancer type of stomach trouble. Repeated examinations of the urine may be necessary; history of increased frequency is often given. These, together with the condition of the heart and blood-vessels, will usually clear up the diagnosis.

The most important condition, that is, the most important to differentiate, is that of pernicious anemia. Unless the blood findings are positive, one is often at a loss in deciding. There may be lack of appetite in both. Dyspeptic symptoms, but not the dislike for food, go with anemia; usually we do not find the pain and vomiting of cancer. In cancer and anemia there may be pain, shortness of breath, and palpitation on exertion, but in anemia these symptoms are much more clearly defined. Rest gives perfect physical ease in anemia, while in cancer the stomach distress and general weakness do not yield completely to quiet. There is less emaciation in anemia, the skin is more apt to be lemon color than colorless, there is an oilier "feel" present, and a slight edema is usually found. Stomach analyses in pernicious anemia are misleading, and if seriously considered, many mistaken diagnoses may be credited to them. Absence of hydrochloric acid and presence of blood are frequent conditions in both. The examination of the blood is invaluable. Poikilocytosis is common in anemia and infrequent in cancer. In anemia the hemoglobin is low, red count low, and color-index high. In cancer, hemoglobin test is frequently high, due to dehydration of blood, and the color-index is not above normal, usually low. Staining the blood and the dis-

covery of the distinctive nucleated red cells of anemia will usually establish the diagnosis. The facial expression is of value. In anemia there is a general paleness and icteric tinge, not the excessive paleness about the eyes and nose. There is a slight puffiness of the tissues and a more hopeful expression; emaciation is less marked, and the wrinkled condition, which in cancer adds so much to the picture of cachexia, is wanting.

(II) The surgical conditions are (1) gall-bladder disease with adhesions, infections, duct obstruction or pancreatitis; (2) large ulcers; (3) saddle ulcers; (4) hour-glass stomach; (5) pyloric ulcers with prolonged histories where obstruction, perforation, or adhesions have developed.

Chronic gall-bladder disease with complications certainly gives serious trouble in differentiation. Late in the illness the stomach symptoms are so typical of grave ulcer or cancer that we are forced to serious consideration. Our hope of differentiation lies in the early history, where if the trouble be in the gall-bladder, we find the typical history of sudden, severe, irregular epigastric attacks, with pain radiating to the right arch and to the back; upward pressure (bursting feel) spasm of the diaphragm; abrupt cessation after a longer or shorter attack. There is no relation to food; there may be jaundice. This early history will often clear up the diagnosis between ulcer and gall-stones and lessen the chances of making the diagnosis of malignant stomach.

Often in the malignant list, or seriously so considered, are patients suffering from large ulcerous lesions. This is true when the destruction is great, loss of blood evident, anemia marked, food intake greatly reduced, emaciation pronounced, and where there is vomiting of large amounts, perhaps coffee-ground in character.

This same picture prevails in many saddle ulcers, in hour-glass stomachs, and among the long histories where at a late period obstruction, perforation, adhesions, and deformities have developed. In any of these histories we may find anorexia, emaciation, hemorrhage by stomach (coffee ground) or bowel, vomiting, cachexia, absence of hydrochloric acid, presence of lactic acid, Oppler-Boas

bacilli, with all the signs of motor insufficiency which is often so marked in cancer.

In cancer, loss of appetite comes early; loss of strength and flesh progresses rapidly and is too marked to be accounted for by time and lessened appetite. This loss of strength is often the first symptom complained of. In ulcer the appetite remains until late, and fear of pain is very often the cause of lessened food intake. Loss of flesh and strength is slow and well accounted for by the forced abstinence. Pain in cancer is more diffuse, more constant, not so closely related to food, and is more depressing. Nausea and vomiting are more irregular and take place when no food is present. In ulcer the vomiting comes at the height of pain and is usually due to food. In cancer vomiting of blood is more frequent, not so copious, and is often altered by detention in the stomach. Hydrochloric acid is often absent; Oppler-Boas bacilli and lactic acid are present. A tumor is frequently palpable. One may almost surely diagnose cancer when a movable tumor of the stomach is demonstrated, which on expiration may be prevented from ascending.

The satisfaction that may follow an exact diagnosis does not justify us in prolonged observation. The chief factor to be considered is what we owe the sufferer. All of this latter group of conditions is purely surgical, and a careful surgical diagnosis being made, we should urge our patients to accept this as reasonable and advise rational treatment. The surgeon who is up to the present-day technic may be trusted to find and correct the existing pathologic condition.

The treatment of carcinoma of the stomach is either palliative or radical, palliative only when the diagnosis is delayed so that hope of surgical aid is lost, or in case operation is refused. Surgery offers the only means of cure, and should be advised in all cases when (1) the diagnosis is made early enough, (2) the location of the cancer makes the case an operable one, and (3) when the promise of relief or cure is likely to yield returns for the suffering, danger, and expense to be borne by the patient. In no other disease is the responsibility of the medical attendant greater, and no measures should be left untried to secure an early, accurate diagnosis. It is

sometimes said that the cures from operative procedure are so few in cancer of the stomach, the relief given so small and prolongation of life so little that we are not justified in putting our patients into the surgeon's hands. This may be true (1) if the cancer is diffuse or the distant glands infected, so that removal is beyond hope. This cannot always be absolutely determined before operation, so we must act on the possibility of doing something positive. (2) If the diagnosis is not made until tumor, cachexia, and all positive symptoms appear, then we should know that the distant parts are invaded and the case is beyond the surgeon's aid. (3) It is also quite as true that if we cannot turn our patients to a surgeon who has mastered present-day technic, that we might better leave them to palliative treatment. But there are scores of surgeons in this country to whom we may trust our patients with the utmost confidence that the right thing will be done despite any error that may have been made in the diagnosis. There are, on the other hand, scores and scores of men who have not learned in the proper school of experience, and to whom we should not turn even a simple case of appendicitis, "as soon as the diagnosis has been made." In the ranks of the latter is a great multitude of self-styled surgeons who are continually at war with the internist, criticizing his methods, his failures in diagnosis, and his hesitancy in turning over to the surgeon any cases he may have in charge. It is this class of "knockers" that is doing the most to delay the proper and close alliance between the progressive internist and the conservative surgeon.

We certainly have a problem before us. Not one for the medical man alone, not one for the surgeon only, but one that calls for the best combined efforts of surgeon and internist.

The problem is to evolve a method of *early diagnosis in cancer of the stomach*, so that the sufferer may be offered a chance of cure. The horizon is gradually widening. Good has come and is coming yet more rapidly through earlier diagnosis and competent surgery. The near future promises much. In cancer of the stomach the internist must concern himself with but one thing—early diagnosis. That which the surgeon must demand to-day, that which enters almost solely into his promise of cure, and that alone which

places him beyond merely an operator, is accurate and early diagnosis. There is but one thing for which the patient should return real gratitude to his physician, and that is for an early diagnosis.

When a definite diagnosis or a strong suspicion of cancer exists, there is known to-day but one line of treatment to follow or advise. Surgery alone offers hope of amelioration or cure. It is our imperative duty as internists and surgeons to see that the patient gets the best that is available in diagnosis and in technic.

STATISTICS GATHERED AND COMPILED BY DR. DONALD
GUTHRIE

There have been 191 resections for cancer of the stomach in St. Mary's Hospital, Rochester, Minn. Twenty of these resections have been made since the beginning of 1908, and are excluded as valueless in the way of statistics. The cases previous to 1903 are not included because of want of sufficient data concerning them. One patient in this early series is known to have lived four years, and one is alive and well to-day, a period of ten years.

Number deceased, 78, or 61 per cent. Number living, 42, or 33.5 per cent. Questionable, 6.

Number that lived less than 6 months.....	14
Number that lived less than 1 year.....	14
Number that lived between 1 and 2 years.....	16
Number that lived between 2 and 3 years.....	10
Number that lived between 3 and 4 years.....	2
Number that lived over 4 years.....	2
	<hr/>
Died in hospital.....	58
Dead, time unknown.....	14
	<hr/>
Total dead	78
	<hr/>
Number alive 6 months to 1 year.....	11
Number alive 1-2 years.....	9
Number alive 2-3 years.....	14
Number alive 3-4 years.....	4
Number alive 4-5 years.....	3
Number alive over 5 years.....	1
	<hr/>
Total number living.....	42

From 1903 to 1908 there were 126 cases. Number of males, 88. Number of females, 38. Average age of male and female, fifty-one. Average age of males, fifty-two. Average age of females, forty-nine. Number of patients under thirty, 4. Number of patients over seventy, 6. The ages of the remaining 116 ranged from thirty to seventy years.

PROMINENT SYMPTOMS IN THE DIAGNOSIS OF GASTRIC AND DUODENAL ULCERS *

By CHRISTOPHER GRAHAM

The accurate differentiation between duodenal ulcers and ulcers of the pyloric end of the stomach offers great difficulties. When a physician follows his patients from the examining room to the operating table he is forced to the conclusion that to locate a peptic ulcer is not only difficult, but often impossible.

In reviewing the symptoms and diagnostic features of peptic ulcer I shall take the duodenal as the type. What holds good for duodenal ulcers, holds equally good for all ulcers situated in the pyloric end of the stomach. The chief difference arises from the degree in which the characteristic symptoms are manifest.

In this discussion I wish to emphasize but four points that seem to stand out prominently and clearly in the larger number of cases: First, the periodicity of attacks of gastric and duodenal ulcers. Second, the number of years through which these attacks and intermissions or remissions have run before surgical relief has been advised, or perhaps accepted. Third, the characteristics of pain, its great diagnostic significance, and its place in differential diagnosis. Fourth, the ready control of all symptoms during the period of attack by the measures that control pain—as food, alkalies, irrigation, and vomiting.

PERIODICITY

The periodicity of attacks is so constant and striking a feature of ulcer of the stomach and duodenum that one cannot but have in

* Read in the Section on Practice of Medicine of the American Medical Association, at the Fifty-ninth Annual Session, held at Chicago, June, 1908. (Reprinted from "The Journal of the American Medical Association," Aug. 22, 1908, vol. ii, pp. 651-653.)

mind this lesion when the patient complains of repeated attacks, each covering days, with an intermission of normal health of varying time. The onset of symptoms is often initiated without discoverable cause, appearing suddenly and continuing without interruption for days, weeks, or even months, each day a repetition of the former, each meal producing about the same effect; first, ease—later followed by the usual syndrome of pain, or burning distress, gas, sour eructations, and vomiting of sour mouthfuls of varying quantities, all these being at their worst from two to five hours after a meal.

Following this period of attack comes an intermission of days, weeks, or months, appearing, often, as unaccountably and as suddenly as did the distressing symptoms. These attacks recur at irregular intervals for years and continue for varying periods, increasing in intensity perhaps but slowly, the intermission shortening until, finally, the patient may fail to reach at any time that complete ease of previous years. Early in the period of disturbance, and often for years, the interval is one of perfect health and, after the symptoms have disappeared, the patient soon reaches his normal condition. Again, it may be only a partial remission; the patient never quite attains normal, or his "good days" may be only days of moderate ease. The appetite is usually good until complications have changed the character of the symptoms, at which time it becomes necessary to examine carefully into the early history in order to arrive at a logical diagnosis.

These periods of complaint with the periods of intermission, each covering days or months, are so characteristic that, excluding other details, this one feature is often sufficient to warrant a probable diagnosis.

However, periodicity is not of itself peculiar to ulcers of the stomach and duodenum. The character of the attack must be considered carefully. Gall-stone and appendiceal colics recur irregularly, often increase in severity as attacks multiply, may and often do appear suddenly and without known cause. All three have one feature in common; each attack is but a part of the usual round of trouble, and the intermission is but a part of the cycle. In the

latter case no more than in the former may this quiescent period be regarded as that of cure.

LENGTH OF TIME THE SYMPTOMS HAVE PERSISTED

Scarcely less prominent than the periodicity of attacks is the number of years the illness has been manifest before surgical relief has been advised, or perhaps should be advised in many cases, for at first most of these cases are medical and the conservative surgeon does not lay bold hands on them.

However, as one's experience lengthens one is inclined to the belief that error is much oftener to be laid at the door of conservative surgery than at the door of aggressive surgery, and for this reason the sufferer too often fails to get that ready and early relief which is secured only through surgery. In a series of 258 duodenal cases, there were but few with histories of duration of less than one year, and in these the symptoms were clear and often urgent. Usually the history shows that the disease has run from five to twenty years, and not infrequently to thirty and forty-five, the average being just short of twelve and one-half years. Considering the facts of the long series of years with distressing symptoms always promising increase, and as years go by, with invalidism increasing, marked or complete, it seems strange, not that so many patients are urged to seek surgical relief, but rather why surgical measures are not advised sooner, or at least as soon as complications appear which indicate that the medical border-line has been passed.

In the series mentioned here the history of repetition of attacks with intermissions or remissions, together with long years (average twelve and one-half years) of trouble, has been clear-cut in about 90 per cent. of the cases. This should quiet the most conservative internist who feels that surgery is too "freely and flippantly" advised.

SIGNIFICANCE OF PAIN

Pain in gastric ulcer is the most constant symptom and perhaps the most characteristic in its manifestations. Not the kind of pain, not the location of the pain, but the time of the pain is the distinguishing feature. It varies from mild distress to that of great

intensity, and, unless complications have introduced great modifications, its appearance, control, and disappearance are almost if not quite the final evidence required for a correct diagnosis. The pain appears some time after meals; oftener it is as nearly exact to say before meals. Usually in from two to five hours after a hearty meal the burning, gnawing feeling begins, increasing in intensity until vomiting or irrigation has removed the acid-offending material. Food eases the pain; the heartier the meal, the longer the relief. Especially is this true in the history of duodenal ulcer. Gradually, however, this relief lessens, until late in the history and after the patient has long been a "surgical case," food eases but little. When complications (perforations, adhesions, obstruction) are far advanced, food gives no ease and distress follows its ingestion. At this stage relief comes only after ridding the stomach of all offending material by irrigation or forced vomiting.

The pain comes, then, in definite periods of attack; comes daily, or two or three times a day, during this period; comes from two to five hours after meals, and is therefore pre-meal as often as it is after-meal in time. It is epigastric, radiating seldom to other areas, and, except in the later stages, is relieved in part, at least, by food, drink, alkalies, vomiting, and irrigation. The kind of pain depends on the pathologic condition. It may be burning, gnawing, lancinating, boring, cutting (apple-core sensation) or the felling pain of perforation.

Locating an ulcer of the peptic tract from the area of pain as given by the patient is perplexing and often very uncertain. Most of the pain is epigastric, let the lesion be where it may; but the lower the lesion, the oftener is the sensation of pain to the right of the median line, and some ulcers, especially the duodenal variety, give characteristic findings. The longer food gives comfort, other things being equal (as duration of time of disease, extent of trouble, obstruction, etc.), the farther down the ulcer is situated, so that in duodenal ulcer, especially in the early days of its history, food gives relief for a longer time than when the ulcer is located higher, *i. e.*, in the stomach proper. Following this period of ease, the characteristic ulcer symptoms return, of gnawing, boring even to ex-

treme pain, with gas, sour eructation, vomiting of various amounts and intensity, dependent on obstruction and extent of lesion.

There is, however, a pain of the cardia comparable to the boring of a bared apple core, very distressing, foreboding, and sickening, which may be present when the lesion is purely pyloric or duodenal and is doubtless present at times when acidity is high, but purely a functional disorder or due to dietetic error. This pain is brought about by reverse gastric peristalsis, acidity, ulcer, then spasm of the pylorus followed by reverse peristalsis. If the sufferer belches or vomits with difficulty, the annoyance amounts to real pain, and fear of cancer is prominent. These pains come in wave periods of a few moments, and relief follows suddenly and completely at each wave if gas and sour eructation be copiously raised, or the pain gradually recedes to almost quiet, if belching, eructation, or vomiting is impossible. These wave pains repeat until the stomach is relieved by measures that empty it, or they yield readily to sufficient alkalis.

It is seen, therefore, that difficulties arise, and that the most careful attempts at ulcer location fail, but until obstruction is advanced or the lesions large, the best evidence for ulcer localization is the length of time that food gives relief.

Most of the ulcers of the stomach and duodenum (and this is true independent of location) have a longer or shorter spell of relief from food, until late in the disease, at which time the early history is necessary both for diagnosis and localization of ulcer.

There are to-day clinicians who persist in the idea that if ulcer of the stomach is present, food gives immediate pain, or, at any rate, no sense of comfort even for a short time. This is not true in the great majority of peptic ulcers, let the lesion be where it may.

The great number of ulcers are in the pyloric end, and in this region the symptoms are usually typical until complications arise. We then have to consider the conditions that alter the character of the pain. They are: First, large areas (saddle ulcers); second, ulcers well toward the cardia; third, cases in which obstruction is advanced; fourth, hour-glass stomach; fifth, perforation; sixth, adhesions to the gall-bladder or other organs when these adhesions

cause obstruction, immobility, or deformity. In many of the above conditions the patient rarely has any perfect relief, and if there is a brief period of relief, it is so soon followed by greatly exaggerated distress that the interval of ease is lost to most of them.

CONTROL OF SYMPTOMS

All symptoms are usually controlled by the measures directed toward pain. When pain is at its highest, so also is gas eructation and vomiting. By removing, neutralizing, or engaging the acid in the process of digestion, the pain stops, gas no longer forms, vomiting and eructation cease, and the patient enters a period of calm, to return to his former distress some time later. The degree of discomfort depends on the extent of the lesion, the kind of food taken, and the care in its mastication. Until complications (obstruction, perforation, adhesions) have advanced, the pain and other symptoms seem chiefly due to increased acidity and spasm. Reverse gastric peristalsis adds to the discomfort. Later, when complications enter for consideration, the real symptoms are obscured, and the physician is often obliged to grope in the dark for an exact diagnosis, unless the patient has a judicial mind and can relate accurately his earlier symptoms.

Again, the course of ulcer, like cancer, may be long latent, and be diagnosed only when some threatening symptom, like perforation, suddenly prostrates the patient. If the perforation is not complete, or if only a small amount of septic material escapes, the pain may be of short duration, but intensely sharp and lancinating, simulating so closely gall-stone colic that such diagnosis is the only logical one to make. If the perforation is free and the fluid septic or large in amount, the pain is much more intense than in gall-stone colic. There is exceeding great shock, much morphin is required to control the symptoms, and early the appendiceal region will be the center of the pain. Later, if the patient survives, the pain will creep to the duodenum and gall-bladder area. Under such conditions one should think of perforating ulcer rather than gall-stones or appendicitis.

When, therefore, there are attacks of stomach trouble that run

in continuous periods of days or months with intermissions of days, weeks, or months with more or less freedom from symptoms, these periods recurring and occurring over years of time gradually deepening, the symptoms bearing close relation to food and being controlled or modified greatly by dietetic measures, food, drink, and alkalies, we may justly look for ulcer of the stomach or duodenum in a large number of cases.

Purely functional hyperacidity may give symptoms difficult or impossible to differentiate from early ulcer. Appendicitis and more often cholecystitis may run a train of symptoms that will mislead the most painstaking clinician, but these cases are as purely surgical as are typical ulcer cases. Comprehensive surgery finds the source of the trouble and relief is the result. If a mistake is made, it should be that of diagnosis only.

VALUE OF THE TEST-MEAL IN GASTRIC DIAGNOSIS *

BY CHRISTOPHER GRAHAM AND DONALD GUTHRIE

Stomach analyses have misled and may mislead trusting and otherwise trusty physicians. The presence or absence of hydrochloric acid in the stomach contents has been often considered too significant. This special phase of gastric analysis has had, or should have had, its day of security. It is certainly misleading if interpreted independently of the symptoms resting on a carefully developed history. We do not gainsay that the amount of free hydrochloric acid has pointings. It varies at different times and with different test-meals; so also will it vary at different ages. Other conditions equal, the older the patient the less will be the supply or need of hydrochloric acid; therefore our older patients who come to operation show naturally a lessened free hydrochloric acid test, not perhaps because of great area involved in the ulcerous process, not because of pathologic situation, neither by reason of great obstruction nor malignant change, but partly, at least, the natural outcome of age or dissipation fibrosis.

General systemic or local disease of the stomach does modify both the quantity and quality of gastric acid secretions, and we must not wholly overlook this varying acid state as an aid in diagnosis.

In pernicious anemia we have emaciation, pallor, weakness, loss of appetite, perhaps severe vomiting accompanied by blood, gas, and distress following food, and at test-meal very low, and usually no free hydrochloric acid. Shall we diagnosticate malignant disease of the stomach?

* Copyright, 1909, by A. R. Elliott Publishing Company. (Reprinted from "The New York Medical Journal" for Sept. 4, 1909.)

In Bright's disease when the heart has lost its compensation in a measure, and the retarded circulation reacts on the stomach; or again in those more chronic cases when the pathology of the kidney and the condition of the circulation are more difficult to define, when the stomach symptoms predominate and the test-meal shows no free acids, shall we diagnosticate primary stomach trouble?

There are times when the patient with pulmonary tuberculosis gives only stomach symptoms, and the test-meal yields no free hydrochloric acid, yet we would hardly pardon a diagnosis of stomach trouble. In all general debilitating diseases we find this reduction of acids. In the drunkard we may find pernicious stomach symptoms and no free acids. In cardiospasm, in diverticulum, and in esophageal obstruction we may be misled on examining fluid vomited or drawn from these dilated sacs, when supposedly it came from the stomach.

Hyperchlorhydria is seen in (1) oversecretion when the total acids reach one hundred and over. In some of these patients hydrochloric acid may be high, and in others just well above normal. Again, the total acid runs slightly lower (seventy to ninety), while hydrochloric acid reaches sixty or more. There are these two conditions, oversecretion and hyperchlorhydria, and we rather often find them associated. The condition, when surgical, will be diagnosticated when real epigastric pain is present and food remnants are found at test-meal, thus showing loss of motor power, pyloric spasm, or ulcer areas. (2) Again, we find hyperchlorhydria in stomach neurosis; and (3) in chronic appendicitis and gall-stone disease which may cause stomach symptoms due to pyloric spasm.

In ulcer of the stomach and duodenum, we do find high hydrochloric acid contents, as a rule, early in the history. It is also true that in advanced gastric carcinoma we rarely find free hydrochloric acid. In chronic ulcer we may find lessened or absent hydrochloric acid; especially is this condition found among older patients with marked chronic obstruction, or in advanced conditions with large areas of destruction and in hour-glass stomachs. We may find, we do find, in carcinoma of the stomach acids quite normal associated with an advanced pathologic condition.

If we were to give in order of diagnostic value the findings at test-meal, the summary would run about like this: Division A—(1) Food remnants; (2) quantity of secretion rather than quality (with or without food remnants); (3) location of tumor; (4) size of stomach; (5) position of stomach. Division B—(1) Acid contents; (2) blood; (3) bacteria.

In division A the findings relate more or less to the one great factor in gastric pathology—the motor power of the stomach. If the power of the stomach to empty itself holds good in spite of pathologic conditions, nutrition does not fail and stomach symptoms are at a minimum. Quantity and quality of secretion may be functional, but if remnants are found at test-meal, we can justly look to obstruction only as the cause of the disturbed secretion. In division B, blood and bacterial findings are placed last. In the first place, because three-quarters of all ulcers must be diagnosed without blood findings, and bacteria add little of value. In cancer the two are more important, yet here one-third of the cancers show no blood findings and the bacterial aids are of much less value than blood.

The value of acid findings is not to be despised. It has its place and may be the deciding factor. We repeat that the gastrologist must be careful lest he place too much stress on gastric findings. First get an accurate history of the stomach symptoms and the development of the disease, and with this as a basis interpret the test-meal findings.

Test-meals are never given in cases of gastric ulcer with recent hemorrhage, or where there is any serious heart embarrassment. A patient requiring a stomach examination is instructed to eat the night before as hearty a meal as possible, without causing too much distress, of meat, potatoes, rice, and a few dried raisins, and to report at the hospital at 7 o'clock the next morning without breakfast. Here the usual Ewald test-meal is given, and one hour later the contents are withdrawn. Male patients remove coat, vest, drop suspenders, and loosen up trousers. Female patients are prepared by a nurse who loosens all waist-bands and removes the corset. All false teeth are removed and eye-glasses taken off. The

patient sits erect in a chair with a rubber apron on to protect the clothing. The tube is quickly inserted into the stomach without the use of any local anesthetic or lubricant, save warm water. The patient is then told to bend forward and to assist in obtaining the contents by upward pressure over the abdomen with both hands. When the contents are withdrawn, the stomach is washed out with a pint or more of warm water, and it is in the contents and these washings that food remnants are looked for. The patient then rises with the tube still in the stomach, takes a few steps to an examining table, and is placed in a recumbent position. The funnel of the stomach-tube is then removed, and the end of a Davidson bulb syringe is inserted in the tube. The stomach is then outlined by auscultatory inflation, the examiner listening over the stomach area with a stethoscope, while an assistant inflates the stomach. The note heard directly over the stomach caused by each pump of the syringe is a sharp, clear, metallic click of high pitch, while that heard away from the stomach area is a muffled, distant note of lower pitch. In this way, with practice, it is easy to find the limits of the greater and lesser curvature. Inflation is never carried on to a point that causes pain. If the outline is indefinite to the examiner, the syringe is withdrawn and the air expelled from the stomach by direct pressure—the stomach is reinflated. This is one of the advantages of the method over others. While inflated, the stomach is carefully palpated for tumors or ridges, and it sometimes happens that tumors missed in the primary examination are found on inflation. The inflated air is always expelled by pressure before the tube is withdrawn—another advantage of this over other methods. The outline of the stomach is then marked on the patient with an indelible pencil.

The contents are examined grossly for food remnants, then filtered, and tests are made for the acids and blood. For free hydrochloric acid we use Töpfer's dimethylamidoazobenzol test; for total acidity, the phenolphthalein test; for combined acids, the alazarin test. Uffelmann's phenol and tincture of ferric chlorid is used for lactic acid. Volatile fatty acids are tested for by heating some of the filtrate in a test-tube in the presence of blue litmus

paper. The guaiac test is made for blood. If there has been much gagging or straining and small amounts of gross blood appear in the washings, it is designated as traumatic blood.

We have analyzed carefully the gastric findings in 250 cases of ulcer of the stomach and duodenum and 150 cases of carcinoma, which have all come to operation and had the correctness of the diagnosis established. We have also included 100 cases of pyloric spasm due to appendicitis or gall-bladder disease. In another paper, to follow this one, we will give the symptomatology and end-results of operation in a large number of cases of pyloric spasm due to appendicitis. We have also included 100 cases of stomach neurosis, and it is in this class alone that there is any question as to whether the diagnosis was correct or not. For comparison, the stomach findings of 25 cases of pernicious anemia are also added.

ULCER OF STOMACH AND DUODENUM

(250 Cases.)

Free hydrochloric acid present in 237 cases; absent in 13 cases.

Total acidity: Below normal, 28 cases; normal (40-60), 106 cases; above normal, 103 cases (60-80, 67 cases; 80-100, 31 cases; above 100, 5 cases).

Free hydrochloric acid: Below normal, 23 cases; normal (20-40), 102 cases; above normal, 112 cases (40-60, 75 cases; 60-80, 26 cases; above 80, 11 cases).

Blood present.....	49 cases
Lactic acid.....	53 cases
Food remnants.....	73 cases
Tumor.....	3 cases
Blood alone.....	10 cases
Blood and lactic acid.....	21 cases
Blood, lactic acid, and food remnants.....	12 cases
Blood and food.....	6 cases
Lactic acid alone.....	8 cases
Lactic acid and food remnants.....	12 cases
Food remnants without blood or lactic acid.....	43 cases
Prolapse or dilatation present in.....	118 cases

We call attention to the fact that of three-fourths of the cases of ulcer that come to the operating table the patients do not show the high acids, as commonly thought to be the case. The average age of these patients was forty-five years, and the average duration of symptoms more than twelve years, both factors, age and chronicity, tending to reduce the acidity. Young subjects with developing

ulcers have high acid tests. We regard decided food remnants in the test-meal as a surgical indication.

CANCER OF THE STOMACH

(150 Cases.)

Free hydrochloric acid present in.....	70 cases
Average age.....	48 years
Duration of symptoms.....	4½ years
Absent in.....	80 cases
Average age.....	54 years
Duration of symptoms.....	9 years

Free hydrochloric acid present without blood, lactic acid, or food remnants in 24 cases.

Free hydrochloric acid present without blood, lactic acid, or food remnants in 46 cases; in 37 of these cases no palpable tumor present; 33 of these cases had palpable tumor present (blood alone, 15 cases).

Blood present in 80 cases: blood and lactic acid, 20 cases; blood and food remnants, 15 cases; blood, lactic acid, and food remnants, 30 cases.

Lactic acid present in 64 cases; lactic acid alone, 11 cases; lactic acid and food, 3 cases.

Food remnants present in 63 cases.

Food remnants present without blood or lactic acid in 15 cases.

Palpable tumor present in 79 cases.

From this summary it will be noted that a large number of cases of gastric cancer must be diagnosticated independently of the test-meal findings, yet, on the other hand, there are a few cases in which the subjective symptoms are indefinite, and where the test-meal throws the first light upon the real pathologic condition present.

The large percentage of free hydrochloric acid in this class of cases is explained by the fact that cancers of the stomach are diagnosticated earlier and with less hesitation than in former years. We have been impressed with the frequency with which cancer develops upon old ulcer. The latest statistics from our laboratory show that 71 per cent. of the cancers of the stomach developed on an old ulcer base.

We now frequently send a patient to the operating table with a diagnosis of cancer on old ulcer, based solely on the history of chronic ulcer with recent exacerbation, loss of weight, weakness, etc. One should not wait for a palpable tumor, cachexia, and the typical text-book test-meal.

PYLORIC SPASM

(Due to appendicular or gall-bladder disease, 100 cases.)

Free hydrochloric acid present in 84 cases, absent in 16 cases.

Total acidity: Below normal, 14 cases; normal, 35 cases; above normal, 35 cases (60-70, 18 cases; 70-80, 10 cases; 80-90, 6 cases; above 90, 1 case).

Free hydrochloric acid: Below normal, 7 cases; normal, 48 cases; above normal, 29 cases.

Blood alone, 15 cases.

Blood present in 32 cases: blood and lactic acid, 8 cases; blood and food remnants, 3 cases; blood, lactic acid, and food remnants, 6 cases.

Lactic acid present in 24 cases: lactic acid alone, 8 cases; lactic acid and food remnants, 2 cases.

Food remnants present in.....20 cases

Food remnants present alone in.....4 cases

Prolapse or dilatation present in.....58 cases

The tests in these cases, taken independently of the clinical symptoms, vary little from those in ulcer, and do not help us much in drawing any definite conclusions.

FUNCTIONAL NEUROSIS

(100 Cases.)

Free hydrochloric acid present in 95 cases, absent in 5 cases.

Total acidity: Below normal, 5 cases; normal, 34 cases; above normal, 61 cases (60-80, 39 cases; 80-90, 10 cases; 90-100, 8 cases; above 100, 4 cases.)

Blood present in.....11 cases

Lactic acid present in.....14 cases

Food remnants present in.....3 cases

Prolapse or dilatation present in.....68 cases

This summary gives the greatest hydrochloric acid showing, but lacks the force of surgical argument, especially in food remnants, blood, and lactic acid. In the three cases food remnants were found only in small amounts. Our attention has often been directed to the ease with which these dilated and prolapsed stomachs empty themselves.

PERNICIOUS ANEMIA

(25 Cases.)

No free hydrochloric acid in 24 cases; free hydrochloric acid present in 1 case.

Total acidity, 12.

Blood present in.....19 cases

Lactic acid present in.....8 cases

Blood and lactic acid present in.....6 cases

No food remnants present in any case.

Dilatation of the stomach present in.....2 cases

Apart from the food remnants these cases show a test very closely analogous to cancer.

In conclusion, we regard the test-meal as having a place in gastric diagnosis, but we caution against its too liberal interpretation independent of the clinical history.

PATHOLOGIC RELATIONSHIPS OF GASTRIC ULCER AND GASTRIC CARCINOMA *

By LOUIS BLANCHARD WILSON AND WM. CARPENTER MACCARTY

The following report is based on the study of specimens from gastric and duodenal resections and excisions for ulcer and carcinoma, by Drs. W. J. and C. H. Mayo, from January 1, 1905, to April 1, 1909. In five of the cases the material was obtained at autopsy from patients on whom gastro-enterostomies had been done for ulcer or carcinoma, and from whom no material had been removed at the operation. These autopsies, however, were all made within one hour after the death of the patient; consequently all the material was quite fresh when placed in fixatives. The routine examination consisted of the study of fresh material, sectioned and stained by the method of one of the writers.† Blocks of tissue were then fixed in Zenker's fluid and Flemming's chromosmo-acetic fluid and in 10 per cent. formaldehyd. In some instances additional blocks were fixed also in absolute alcohol. The gross specimen was then prepared by Melnikow's modification of Kaiserling's method. The gross specimens were photographed by the method of Wilson and Andrews,‡ either fresh or after fixation. The photomicrographs of sections herewith shown were made from hematoxylin-stained specimens. In these no attempt has been made to show fine detail, which has been sacrificed to a study of the distribution of the cells.

The total amount of material studied comprised specimens from

* Reprinted from "The American Journal of the Medical Sciences," Dec., 1909.

† Wilson, L. B.: "A Method for the Rapid Preparation of Fresh Tissues for the Microscope." "Jour. Amer. Med. Assoc.," 1905, xlv, 1737.

‡ "Stereophotography of Pathological Specimens: Some Improvements in Technique and New Apparatus," "Jour. Med. Research," 1908, xvii, 487 to 494.

218 cases. Eight of these were from the duodenum, and were all simple ulcers. The remaining 210 were from the stomach. Of these, 47 were ulcers without suspicion of carcinoma; 2 were sarcomas, 2 adenomas, and 1 a diverticulum. Of the remaining 158 cases from the stomach, 5 were ulcers with enough microscopic appearance of aberrant epithelial proliferation to place them in the doubtful class as possible transition cases. Of the remaining 153 cases, which were undoubted carcinoma, 109 (71 per cent.) presented sufficient gross and microscopic evidence of previous ulcer to warrant placing them in a group labeled "carcinoma developing on preceding ulcer." Eleven other cases (7 per cent.) showed considerable evidence of precedent ulcer, but not sufficient to warrant placing them in the previous group. In 33 cases (22 per cent.) there was relatively small or no pathologic evidence of precedent ulcer.

It is unnecessary to review the enormous literature of this much discussed subject. For years the pendulum of opinion swung back and forth, and it has been only within the last decade that sufficient material from early cases has been collected to give a clear understanding of the facts. The reports on specimens removed at operation during that period have practically settled the question as to the very frequent occurrence of gastric carcinoma on the site of previous ulcer. Our excuse for offering these cases at present is to place them on record as one more bit of evidence to clear up a misconception which has done much harm in the past, and which still exists, as is shown by the attitude of the author of the most exhaustive recent work on cancer.*

PROTOCOLS

CASE No. 22,826 (Fig. 25).—This specimen is from a woman, aged twenty-six years, who for nine years had had some stomach distress, some gas, occasional vomiting, and eructations. For the last eight weeks she had had some loss of strength, had lost in weight (20 pounds), and had vomited occasionally. Stomach analysis showed a total acidity of 65, free hydrochloric acid 50, lactic acid

* Williams' "Natural History of Cancer," Wm. Wood & Co., 1908, pp. 279 to 280.

absent, and blood absent. Operation revealed a chronic ulcer of the lesser curvature. Fig. 26 shows the scar tissue and the eroding base of the ulcer, within which are no epithelial inclusions. The character of the lesion deep down below the overhanging border, just where the mucosa comes in contact with the basement membrane, is shown in Fig. 27. Here are numerous groups of epithelial cells cut off by the products of inflammation.

CASE No. 22,020.—The specimen in this case is through the pylorus of a man, aged fifty-one years, who for three years had had some stomach distress with gas, vomiting, etc. For three months he had had some loss of strength and loss of weight (15 pounds), with severe pain. The stomach analysis showed a total acidity of 56, free hydrochloric acid 30, lactic acid absent, blood absent. This case much resembled the preceding one. Fig. 29 shows the eroding mucosa with swollen epithelial cells in the overhanging border of the ulcer. Fig. 30, from near the base of the mucosa, shows several small groups of epithelial cells which are segregated from the rest of the mucosa, as in Case 1.

These two cases show how in chronic gastric ulcers in which no carcinoma is demonstrable there already exist isolated areas of epithelium which is under conditions favorable to its aberrant proliferation.

CASE No. 18,088 (Fig. 31).—This specimen is from the pyloric half of the stomach from a man, aged forty-five years, who had only mild symptoms of so-called dyspepsia until nine months ago, when he began to have marked gastric distress, vomiting blood, gas, eructations, loss of appetite, loss of strength, and loss in weight (60 pounds). The stomach analysis showed a total acidity of 50, free hydrochloric acid 12, lactic acid absent, blood present. Operation showed multiple ulcers of the lesser curvature. Three of these were carcinomatous. Fig. 32 is a section from the overhanging border of the ulcer showing the least amount of carcinoma. Fig. 33 is a section from deeper down in the tissues showing the isolated groups of epithelial cells proliferating and infiltrating.

CASE No. 18,867 (Fig. 34).—This specimen is from a woman, aged sixty years, who for twenty-five years had had more or less severe stomach symptoms, distress, vomiting, gas, etc. For the last six months she had had considerable loss of strength, loss of weight, and severe persistent pain. Analysis of the stomach con-

tents showed a total acidity of 60, free hydrochloric acid 45, lactic acid absent, blood absent. Operation revealed a carcinoma on an ulcer of the lesser curvature. Fig. 35 is from the ulcerating portion of the stomach lesion. Fig. 36 is of a section showing the proliferation of the epithelium without infiltration. Fig. 37 is from a section showing the true carcinomatous character of the lesion.

CASE No. 16,525 (Fig. 38).—This specimen is from a male, aged forty-six years, who for seven years had had considerable stomach distress with vomiting and eructations of gas. For the last seven months he had had loss of strength and appetite and had lost 45 pounds in weight, being now quite emaciated. The stomach analysis showed a total acidity of 42, with a free hydrochloric acid content of 37, lactic acid present, and blood present. On operation there was found a carcinoma on the border of an ulcer covering a greater portion of the lesser curvature. Fig. 39 is of a section from the ulcerating border showing cross-sections of distended glands with round cells between. Fig. 40 shows the bases of glands clipped off by scar tissue. Fig. 41 shows active proliferation in segregated epithelium. Though strongly suggestive of carcinoma, one would hesitate to diagnosticate this section, since the field is obscured by the round-cell infiltration. Fig. 42, however, shows typical scirrhus cancer, that is, the inflammation has here subsided and the fibrous tissue has increased around the islands of proliferating epithelium. These four sections are all from the border of the ulcer, but in successive microscopic steps away from its center.

CASE No. 15,681 (Fig. 43).—This specimen is from a man, aged thirty years, who has suffered from gastric distress, nausea, vomiting, and gaseous eructations for five years. During the last seven months he had had marked loss of strength, with a loss of 30 pounds in weight. Stomach analysis showed a total acidity of 62, free hydrochloric acid 32, lactic acid absent, and blood present. Operation revealed a carcinoma on an extensive ulcer of the lesser curvature, involving also the pylorus. Fig. 44 is from a section from the base of the ulcer. Fig. 45 is of the overhanging border nearest the ulcerating area, showing segregated proliferating epithelial masses. Fig. 46 is of an area a little farther removed from the ulcerating area than the preceding section.

CASE No. 16,651 (Fig. 47).—This is a specimen from a woman, aged forty-two years, who for sixteen years had had intermittent stomach distress with vomiting, etc. For the last four months she had had considerable loss of strength, weight, and appetite. Stom-

ach analysis showed a total acidity of 50, with free hydrochloric acid absent, lactic acid absent, and blood present. The gross specimen shows a lesion of the lesser curvature. Fig. 48 is of a section from the edge of the ulcer showing at the right side the old scar tissue in the border of the ulcer, and at the left side the carcinoma advancing into the scar.

CASE NO. 21,555 (Fig. 49).—This specimen is from a man, aged sixty-seven years, who for twelve years had had considerable stomach distress, including vomiting, eructations, gas, etc. During the last few months he had grown considerably worse, had lost strength, appetite, and 35 pounds in weight. The stomach analysis showed a total acidity of 30, free hydrochloric acid 15, lactic acid absent, and blood present. The gross specimen showed a large ulcer of the lesser curvature, which is further shown in gross section in Fig. 50, in which the character of the ulcer can be more clearly made out. Fig. 51 shows the carcinoma advancing into the scar tissue at the edge of the ulcer. Fig. 52 is from material at the base of the overhanging mass, and shows scirrhus carcinoma change.

CASE NO. 19,322 (Fig. 53).—This specimen is from a man, aged thirty-three years, who for ten years had had symptoms of gastric ulcer, that is, distress, vomiting, gas, eructations, etc. During the last eight months he had had considerable loss of appetite with a loss of 50 pounds in weight. The stomach analysis showed a total acidity of 35, free hydrochloric acid 14, lactic acid absent, and blood absent. The gross specimen closely resembles a simple ulcerated pylorus. In one area, near the greater curvature, however, a nodular mass may be seen which suggests carcinoma. The character of the isolated islands of mucosa at this point is shown in Fig. 54; in Fig. 55 is shown the carcinomatous invasion of the scar tissue in the edge of the ulcer.

CASE NO. 16,636 (Fig. 56).—This specimen is from a man, aged forty-six years, who for ten years had shown marked stomach symptoms, distress, gas, eructations, etc., and for the past eight months had loss of strength, appetite, and 70 pounds in weight. The stomach analysis showed a total acidity of 35, free hydrochloric acid absent, lactic acid present, and blood present. The specimen shows an enormous thickening of the muscularis and submucosa. On this mass of scar tissue is developing a carcinoma. Fig. 57 is of a section from the lesser curvature area, showing a group of partially segregated tubular glands, and near the lower edge of the figure a nest of aberrant proliferating epithelium. Fig. 58 shows the development of the carcinoma in the scar tissue.

CASE No. 14,857 (Fig. 59).—This specimen is from a man, aged fifty-one years, with a history of chronic stomach trouble for ten years, nausea, vomiting, gas, distress, etc. During the last six months these symptoms have been markedly increased and the patient has suffered a loss of 30 pounds in weight. The gross specimen shows the site of an old perforating ulcer, the muscularis being completely broken through, and the adhesions from the old perforation being quite evident. The carcinoma fills the site of the ulcer. Fig. 60 shows a carcinoma developing within the scar tissue. Judging from the microscopic appearance alone, one might hesitate to decide that this was a case of precedent ulcer, although the bands of scar tissue with masses of epithelium included are quite suggestive. The gross specimen with the history, however, is sufficient to warrant a positive diagnosis.

CASE No. 15,351 (Fig. 61).—This specimen is from a man, aged forty-one years, who for many years (fifteen or more) had had gastric distress, vomiting, and eructations of gas. In the last six months he had had a loss of strength, and a loss in weight of 30 pounds. The stomach analysis showed a total acidity of 25, free hydrochloric acid absent, lactic acid present, and blood present. The gross specimen shows a large ulcer of the lesser curvature and a small carcinoma developing in a raised island of tissue in the base of the ulcer near one edge. It is the only instance of the kind in our series.*

CASE No. 18,514 (Fig. 62).—This specimen is from a female, aged forty-one years, who had for three years suffered gastric distress, vomiting, gas, eructations, etc. In the last six months she had had marked loss of appetite, loss of strength, and loss in weight (60 pounds). The stomach analysis showed a total acidity of 100, free hydrochloric acid absent, lactic acid present in large amounts, and blood present. The specimen showed a widely diffused cancer on a large ulcer of the lesser curvature.

CASE No. 14,949 (Fig. 63).—This specimen is from a man, aged thirty-one years, from whom no history of any stomach trouble could be elicited prior to that beginning one year ago, when he began to have nausea, vomiting, loss of strength, and loss of 65 pounds in weight. Stomach analysis showed a total acidity of 10, free hydrochloric acid absent, lactic acid present, and blood present. A gross section through the lesser curvature of the stomach is here shown. The stomach wall at this point was from 2.5 to 4 cm. thick. The

* The microscopic details in this and most of the succeeding cases are omitted for lack of space. They were closely parallel with those already shown.

lesion was purely of an ulcerous character for the lower 8 cm. of the lesser curvature; about 2 cm. of the upper portion of the lesser curvature showed a rapidly growing carcinoma, which had formed metastases in the adjacent glands.

This case is presented to show the unreliability of ever-so-well-taken clinical histories, particularly in the young male, who is not accustomed to give much attention to slight stomach trouble. There can be no question that this patient had stomach ulcer for years preceding the onset of cancer.

The preceding nine cases are fair representatives of those gastric resections for carcinoma in which we consider the pathologic evidence of preceding ulcer sufficient to warrant such a diagnosis.

CASE NO. 16,824 (Fig. 64).—This specimen is from a man, aged forty-three years, who was apparently well until one year ago, when he began to show stomach distress, with gas, loss of strength, and loss of weight (40 pounds). The stomach analysis showed a total acidity of 25, with free hydrochloric acid 8, lactic acid present, and blood present. The specimen shows a small carcinoma of the pylorus, without gross evidence of previous ulcer. Fig. 65 is from a deep level of a section and shows adenocarcinoma. We would not seem to be warranted in making any diagnosis of preceding ulcer in this case of carcinoma, either from the history or the pathologic evidence.

CASE NO. 16,806 (Fig. 66).—This is a specimen from a man, aged sixty-eight years, who during the last thirty years had had three prolonged attacks of stomach trouble, marked distress, gas, vomiting, eructations, etc. During the last eight months he had had loss of strength, loss of appetite, and a loss of 30 pounds in weight, and there was also severe persistent pain. Stomach analysis showed a total acidity of 30, free hydrochloric acid absent, lactic acid present, and blood present. Two-thirds of the stomach was removed. Only a small portion of the specimen is here shown—a section through the wall of the lesser curvature, which was about 3 cm. thick. Colloid degeneration with deposition of lime salts had occurred throughout the wall of the removed portion of the stomach. In this case there is absolutely no pathologic evidence of the occurrence of previous ulcer, although the thirty-year history is very strong clinical evidence.

These last two cases represent the group of 33 (22 per cent.) of our cases, in which we could find insufficient pathologic evidence to warrant a diagnosis of preceding ulcer. The latter case also is a fair example of the type of case which frequently comes to autopsy and shows no evidence of preceding ulcer.

The preceding cases are fair representatives of our series. The 109 cases (71 per cent.) which present pathologic evidence, gross and microscopic, parallel with that shown in detail herewith, that is, large ulcers with scar tissue centers and overhanging borders, deep in the bases of which cancer is present, in almost every instance have unmistakably originated on the lesser curvature of the stomach, the usual site of gastric ulcer. Further, almost every case gives a clinical history suggesting gastric ulcer for a long period of years preceding the relatively short period when the history became that of gastric cancer.

That carcinomas should develop in the edges of gastric ulcers is only what we should expect; the wonder is that the facts should have been so long in being recognized. This has been due to: (a) Failure to recognize clinically the frequency of gastric ulcer; (b) failure to recognize that gastric cancers are not initially pyloric tumors, but extensions thereto from the lesser curvature; and (c) giving undue weight to observations at autopsies. When the patient has died of gastric cancer, the neoplasm has usually obliterated all gross and microscopic evidence of previous ulcer.

As the pathologist examines stomach specimens from the surgical clinic he constantly observes the various steps in the following sequence:

1. Chronic ulcers from the centers of which the mucosa has disappeared, leaving a scar tissue base.
2. In the overhanging borders of the ulcers the mucosa is proliferating.
3. Deep in the borders many groups of epithelial cells have been nipped off by scar tissue and are exhibiting all stages of aberrant proliferation with infiltration of the surrounding tissues.
4. Metastases are forming in the lymphatics of the stomach wall and adnexa.

A small percentage of cases operated upon are too far advanced to show these steps, and a very small percentage—probably not over 2 per cent.—give evidence of rapid aberrant epithelial proliferation and infiltration without any sign of previous ulcer.

Adopting Adami's* classification we may therefore correctly designate most gastric carcinomas as "blastomas originating from unipotential cells of postnatal displacement," although it is probable that a very small number are "blastomas originating from unipotential cells that assume neoplastic characters without displacement and rapidly assume malignancy."

* "Principles of Pathology," 1908, i, 770.

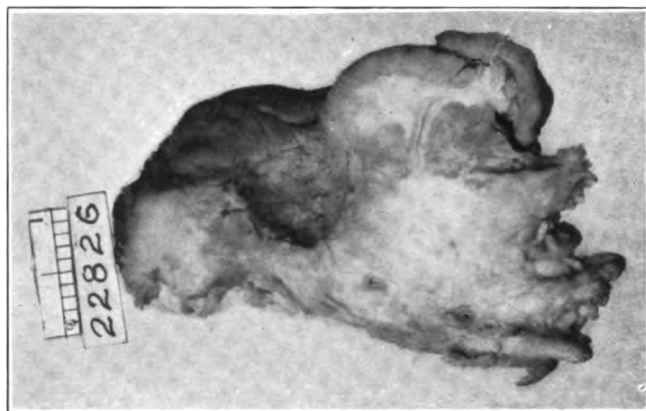


Fig. 25.—(Case No. 22,826).—* Stereogram of a chronic ulcer of the lesser curvature of the stomach. Note the overhanging mucosa, the perforation of the muscularis, and the large mass of adhesions.

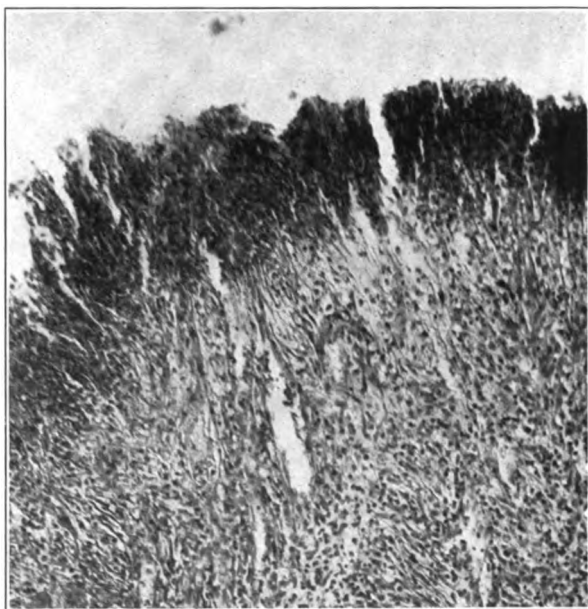


Fig. 26.—(Case No. 22,826).—Photomicrograph of the base of the ulcer. ($\times 100$.)

* These pictures were originally shown as stereograms, but are here reproduced as single pictures only.

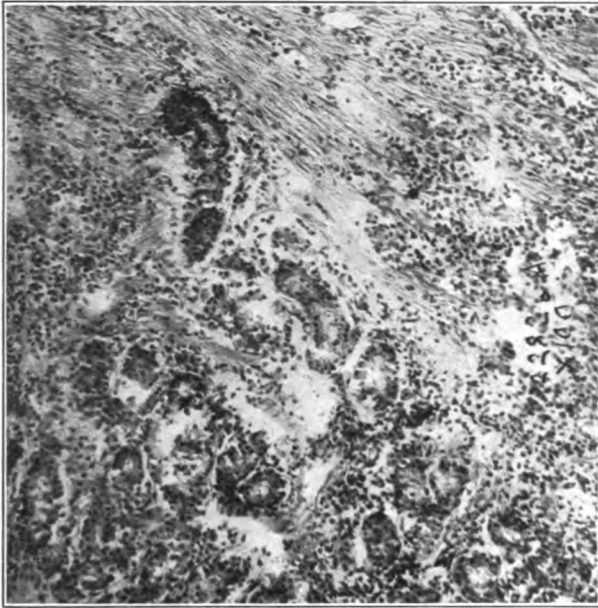


Fig. 27.—(Case No. 22,826).—Photomicrograph showing groups of normal epithelium (bases of glands) cut off by products of inflammation deep under the overhanging border of the ulcer. (X 100.)

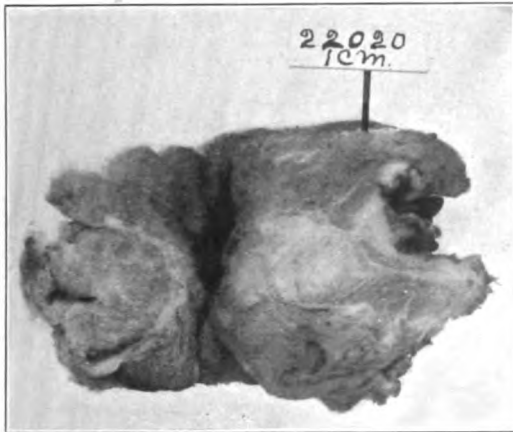


Fig. 28.—(Case No. 22,020).—Stereogram of a section through the pylorus, showing the eroded mucosa of a chronic ulcer.

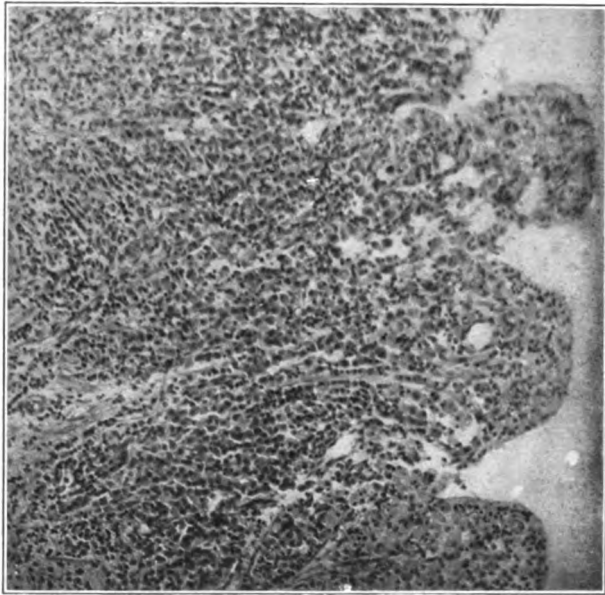


Fig. 29.—(Case No. 22,020).—Photomicrograph of the eroding border of the ulcer. ($\times 100$.)

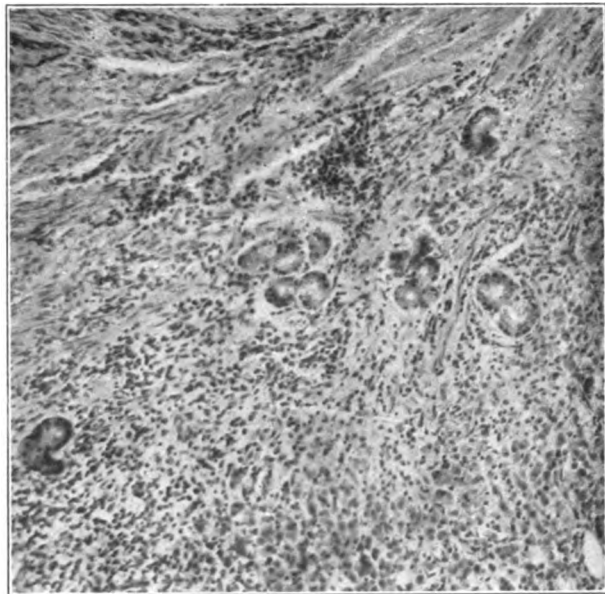


Fig. 30.—(Case No. 22,020).—Photomicrograph of the base of the ulcerating mucosa, showing isolated groups of epithelium. ($\times 100$.)



Fig. 31.—(Case No. 18,088).—Stereogram of the pyloric one-third of the stomach, looking at the lesser curvature; multiple ulcers; a mass of cancerous tissue was removed from the area near the number needle.

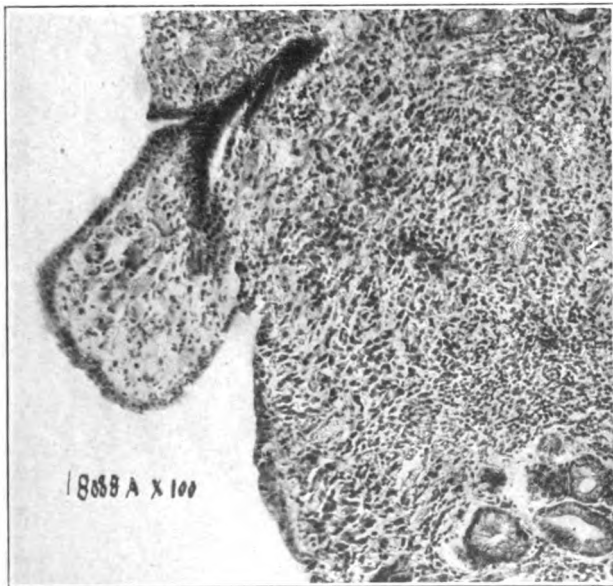


Fig. 32.—(Case No. 18,088).—Photomicrograph from the overhanging border of the ulcer. ($\times 100$).

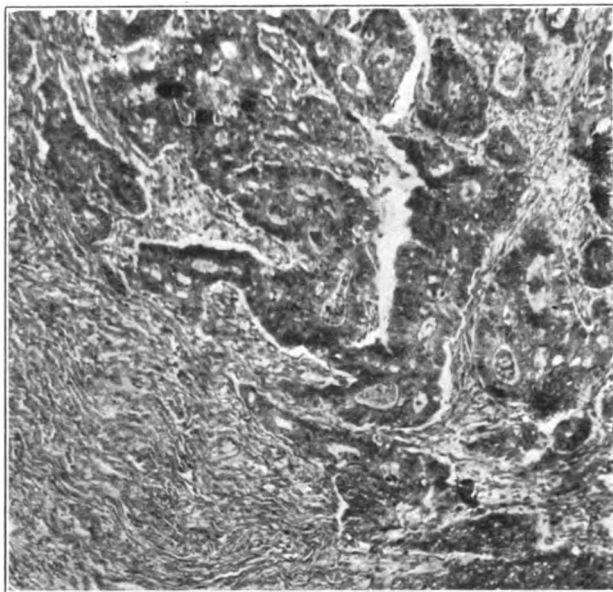


Fig. 33.—(Case No. 18,088).—Photomicrograph from an area deeper than that shown in Fig. 32. The epithelium shows aberrant proliferation and infiltration. ($\times 100$.)



Fig. 34.—(Case No. 18,867).—Stereogram of the lesser curvature, showing proliferation of the muscularis by an ulcer with carcinoma in the border.

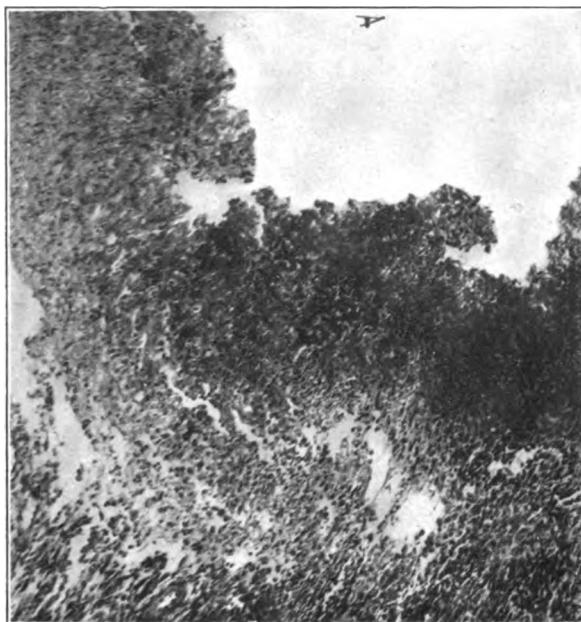


Fig. 35.—(Case No. 18,867).—Photomicrograph of the base of the ulcer. ($\times 100$.)

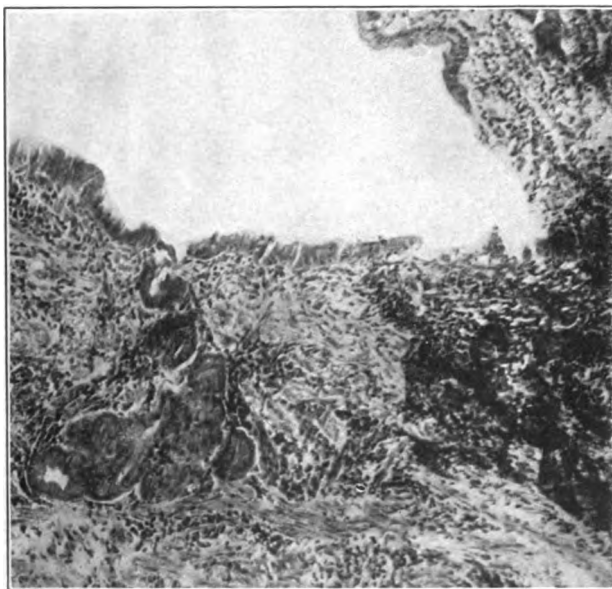


Fig. 36.—(Case No. 18,867).—Photomicrograph showing groups of epithelial cells partially cut off from the surface, actively proliferating but not infiltrating the surrounding tissues. ($\times 100$.)

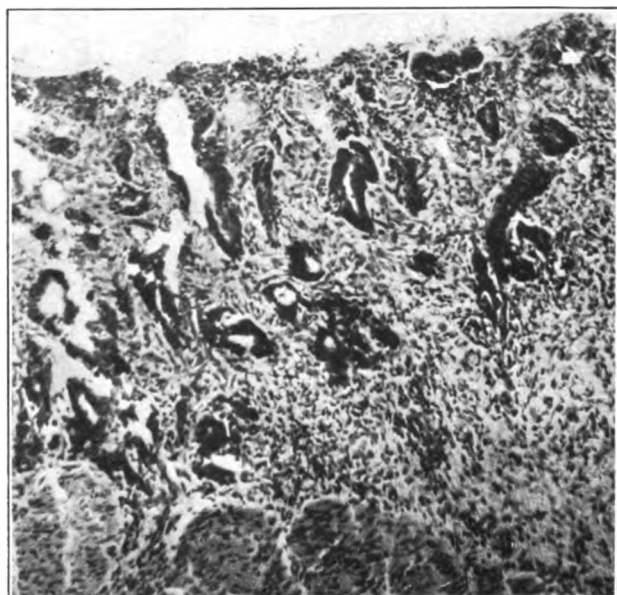


Fig. 37.—(Case No. 18,867).—Photomicrograph showing typical carcinoma. (X 100.)



Fig. 38.—(Case No. 16,525).—Stereogram of the pyloric two-thirds of the stomach; carcinoma on a large ulcer beginning in the lesser curvature.



Fig. 39.—(Case No. 16,525).—Photomicrograph showing a cross-section of the swollen glands with round-cell infiltration between the glands. ($\times 100$.)

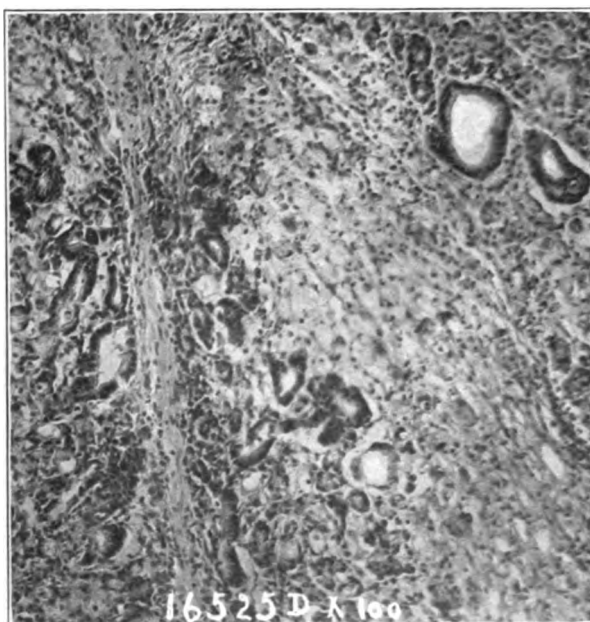


Fig. 40.—(Case No. 16,525).—Photomicrograph showing the bases of the glands clipped off by scar tissue. ($\times 100$.)



Fig. 41.—(Case No. 16,525).—Photomicrograph showing active proliferation and much round-cell infiltration. ($\times 100$.)



Fig. 42.—(Case No. 16,525).—Photomicrograph showing typical scirrhus cancer. Figs. 39-42 are from the border of the ulcer, but in successive microscopic steps away from its center. ($\times 100$.)



Fig. 43.—(Case No. 15,681).—Stereogram of a portion of the pyloric one-half of the stomach, showing carcinoma of the lesser curvature involving also the pylorus.

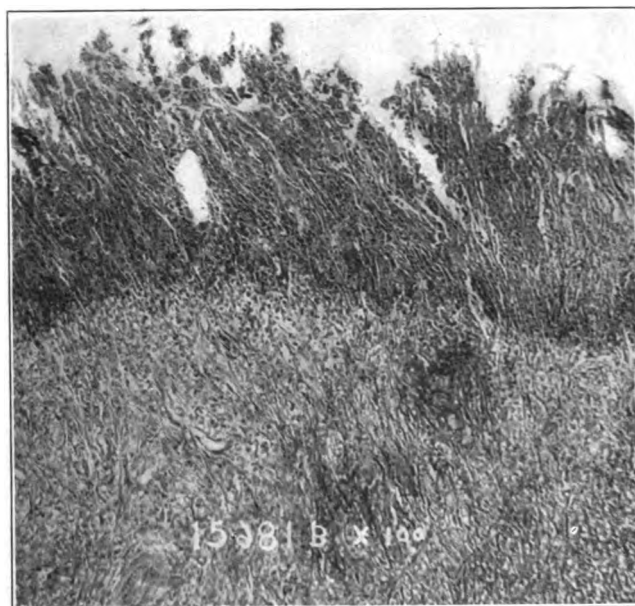


Fig. 44.—(Case No. 15,681).—Photomicrograph from the base of the ulcer. (X 100.)



Fig. 45.—(Case No. 15,681).—Photomicrograph showing proliferating epithelial masses at the swollen mucosa; edge of the ulcer. ($\times 100$.)

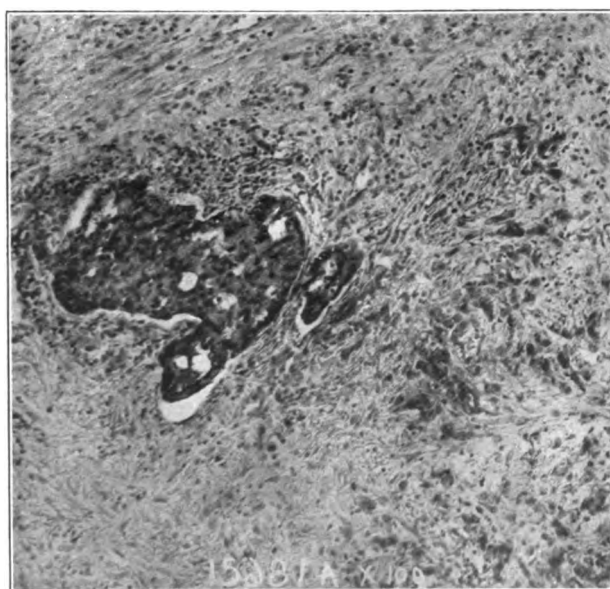


Fig. 46.—(Case No. 15,681).—Photomicrograph showing an area a little farther removed from the ulcerating area than the preceding section (Fig. 45). ($\times 100$.)

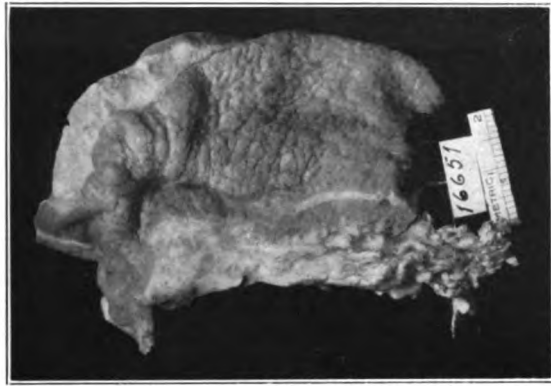


Fig. 47.—(Case No. 16,651).—Stereogram of a portion of the pyloric one-third of the stomach: showing carcinoma involving the lower lesser curvature and pylorus.

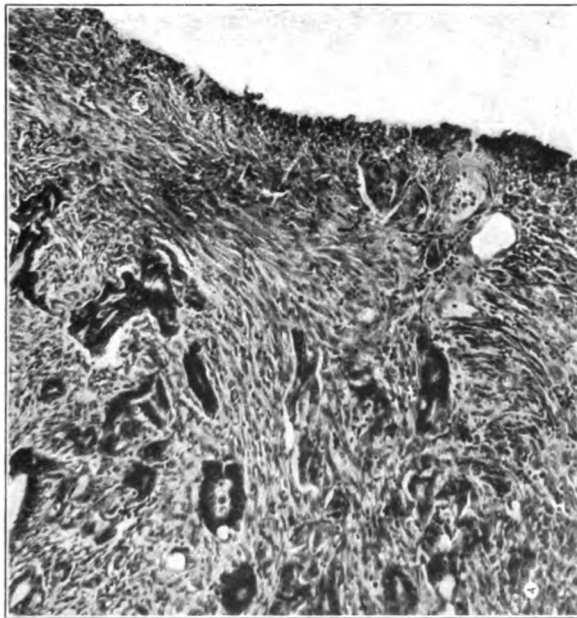


Fig. 48.—(Case No. 16,651).—Photomicrograph of a section from the ulcer border, showing at the right side the ulcer base and at the left the developing carcinoma. ($\times 100$.)

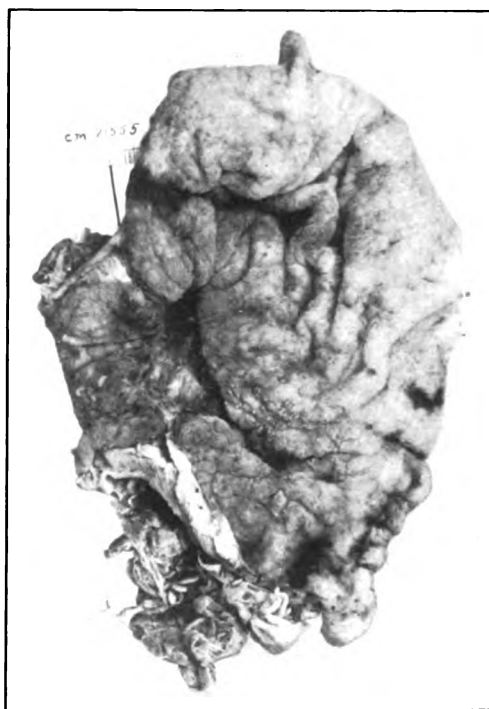


Fig. 49.—(Case No. 21,555).—Stereogram showing carcinoma on a large ulcer of the lesser curvature of the stomach.



Fig. 50.—(Case No. 21,555).—Stereogram of a gross section through a carcinoma and ulcer.

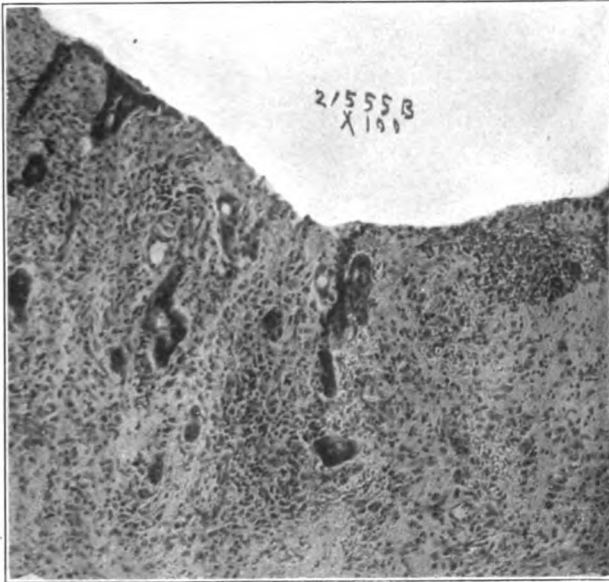


Fig. 51.—(Case No. 21,555).—Photomicrograph from the edge of an ulcer; base of the ulcer at the right; separated bases of tubular glands showing early carcinomatous changes at the left. ($\times 100$)

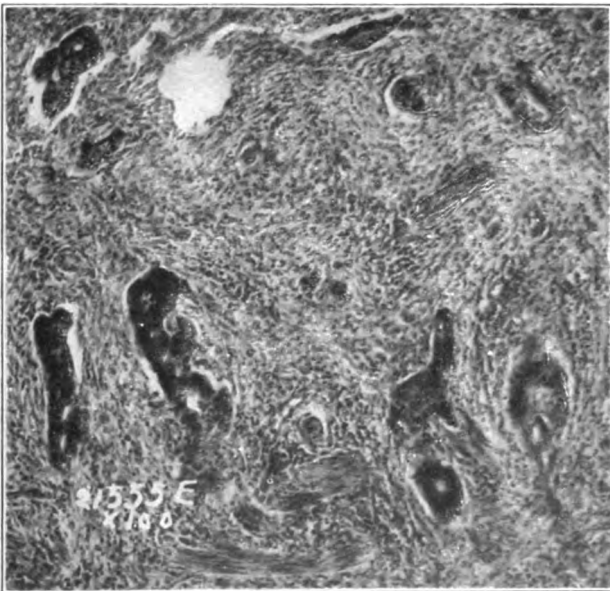


Fig. 52.—(Case No. 21,555).—Photomicrograph of a section from under the base of the overhanging edge, showing scirrhus cancer. ($\times 100$.)

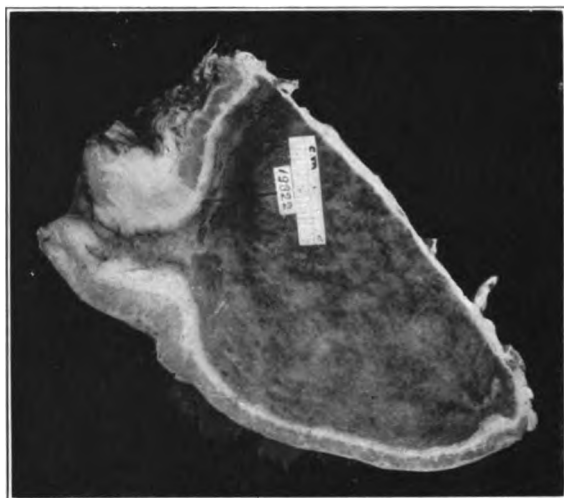


Fig. 53.—(Case No. 10,322).—Stereogram showing a “ring cancer” of the pylorus (originated in an ulcer of the lesser curvature)

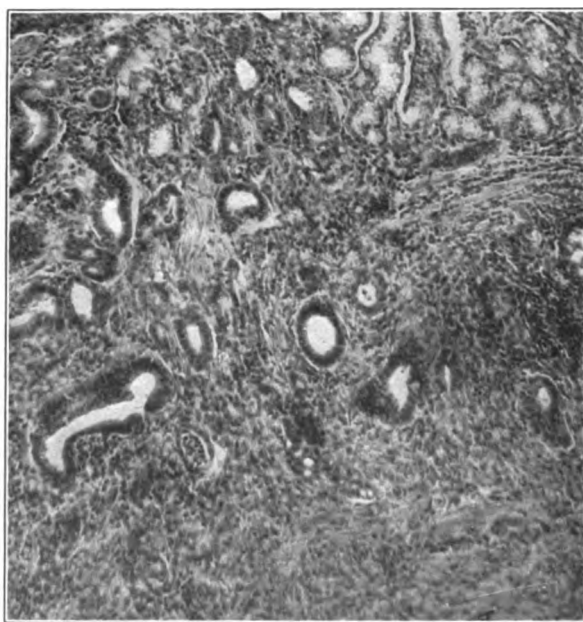


Fig. 54.—(Case No. 10,322).—Photomicrograph showing islands of proliferating epithelium at the base of the mucosa of the overhanging border of an ulcer. (X 100.)

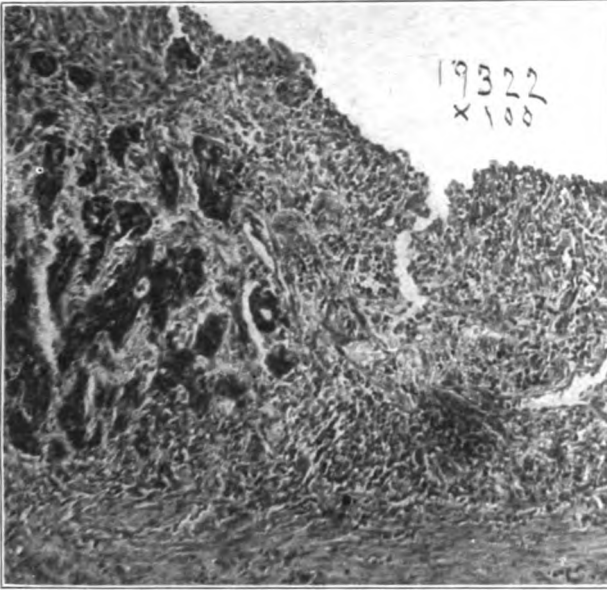


Fig. 55—(Case No. 19,322).—Photomicrograph showing the base of the ulcer at the right, and carcinoma in the border at the left. ($\times 100$.)



Fig. 56.—(Case No. 16,636).—Stereogram showing a large ulcer of the lesser curvature with carcinoma in the border.



Fig. 57.—(Case No. 16,636).—Photomicrograph showing a group of partially segregated tubular glands, and, at the lower right-hand corner, one nest of aberrant proliferating epithelium. ($\times 100$.)

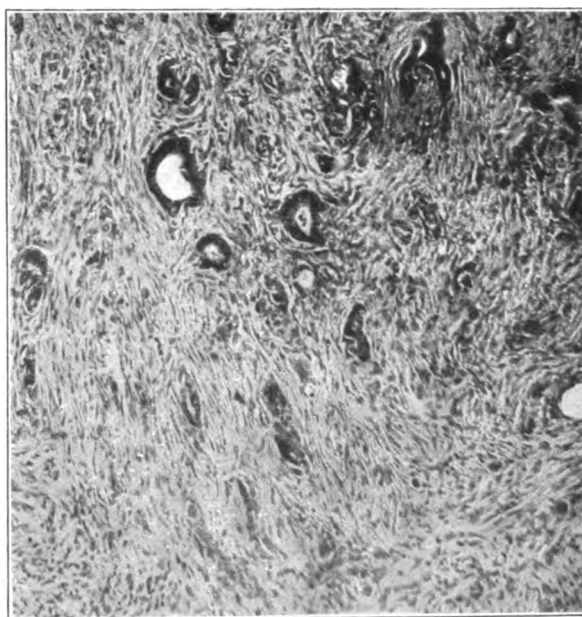


Fig. 58.—(Case No. 16,636).—Photomicrograph showing the development of carcinoma in the scar tissue in the edge of an ulcer. ($\times 100$.)



Fig. 59.—(Case No. 14,857).—Stereogram showing a carcinoma filling the site of an old perforating ulcer of the stomach.

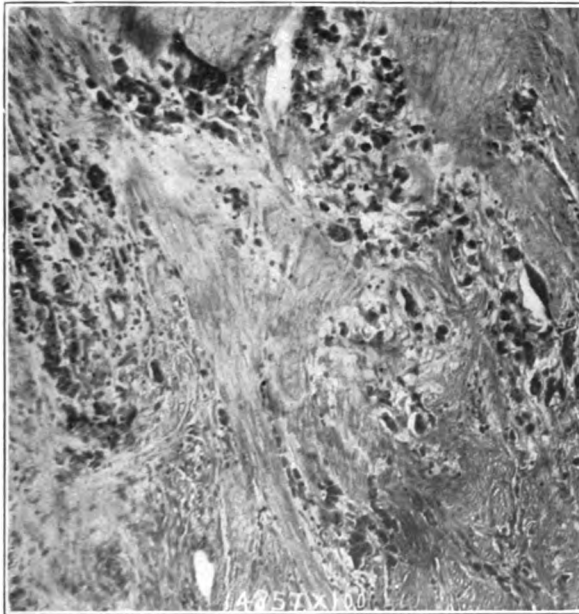


Fig. 60.—(Case No. 14,857).—Photomicrograph showing a carcinoma with scar tissue. (X 100.)

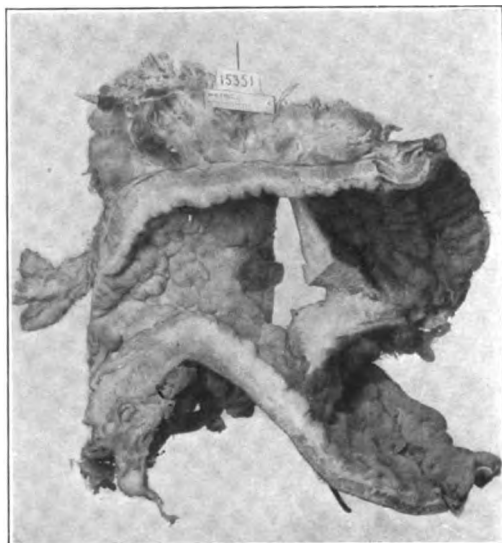


Fig. 61.—(Case No. 15,351).—Stereogram showing a carcinoma in a small raised island of tissue in the base but near the edge of a large ulcer of the lesser curvature.

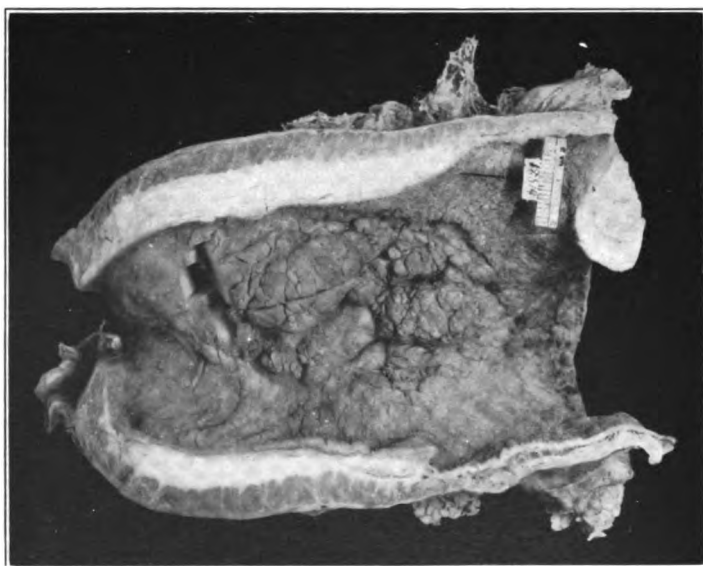


Fig. 62.—(Case No. 18,514).—Stereogram showing an extensive carcinoma on a large ulcer of the lesser curvature.



Fig. 63.—(Case No. 14,949).—Stereogram of a gross section through the pylorus and the lesser curvature showing an ulcer of the lower 8 cm. of the lesser curvature and carcinoma about 2 cm. above; metastasis in the glands.

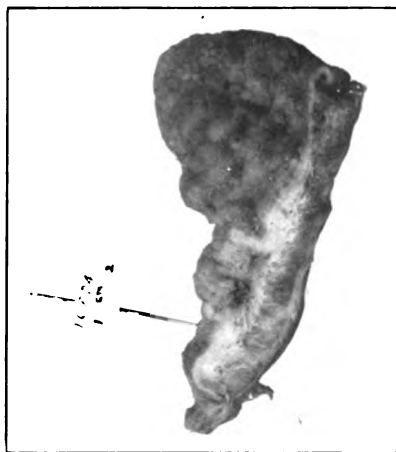


Fig. 64.—(Case No. 16,824).—Stereogram showing a small early carcinoma of the pylorus without pathologic evidence of previous ulcer.

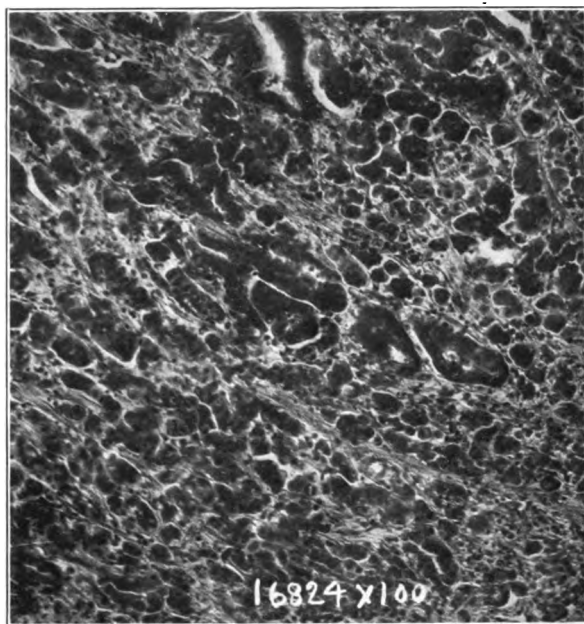


Fig. 65.—(Case No. 16,824.)—Photomicrograph showing an early adenocarcinoma. ($\times 100$.)

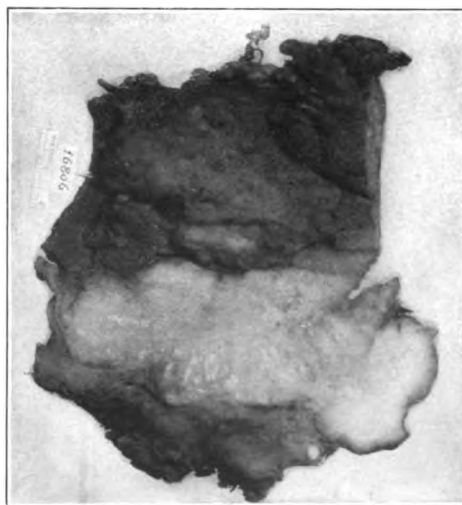


Fig. 66.—(Case No. 16,806).—Stereogram of a portion of the stomach wall showing carcinoma with colloid degeneration and deposition of lime salts; no pathologic evidence of previous ulcer.

DIAGNOSIS OF GASTRIC ULCER WITH DIFFERENTIAL DIAGNOSIS *

By CHRISTOPHER GRAHAM

Ulcers of the stomach and duodenum have a definite symptomatology. When they are located in the duodenal and pyloric areas, it is usually clear-cut and simple. When they are located in the pyloric end of the stomach or along the lesser curvature, we do not usually find marked variation in the course of the symptoms, but it is a fact that as the lesion is found farther and farther from the pylorus the symptoms may lose some of their clear-cut significance, and fail to give that almost pathognomonic course of the duodenal form. However, in the great number of peptic ulcers the type of symptom is fairly suggestive, and a careful development of the history will lead closely, not only to a good diagnosis, but often to a degree of precision in ulcer location.

What, then, is this train of symptoms that so closely typifies ulcer of the stomach? Consider, first, its chronicity. The patient rarely fails to relate clearly and precisely that it has been many years since he first began to experience gastric disturbance, mild perhaps in its beginning, of short duration, and but little disturbing to his general health and usefulness. He will tell us that, as the years have gone by, the trouble has been of the same type, has gradually increased in severity until finally he has little or no relief. This period of chronicity varies from one to twenty years, often running thirty to forty-five. The average number of years in our series is between twelve and thirteen. The second characteristic feature, and one usually clear to the patient, is the periodicity of

* Read before the fifty-ninth annual session of the Illinois State Medical Society, May 18, 19, and 20, 1909. (Reprinted from "The Illinois Medical Journal," Aug., 1909.)

attacks. Early in the disturbance he may say the spells came spring and fall, and were not severely annoying. That they came most often without discoverable cause, suddenly, and continued days or weeks without interruption. Each day of the attack was a repetition of the preceding, each meal producing the same effect—first, comfort for one to five hours, then pain, gas, sour stomach, and vomiting. Following these more or less prolonged spells came periods of relief, often suddenly, without known cause, or following a vacation or change of vocation. The periods of attack and relief alternate at irregular intervals for years, and continue for varying periods. The intermission gradually decreases; the attacks come oftener, increase in severity perhaps but slowly until the severer complications have crippled the efficiency of the stomach. Then the patient fails to reach at any time his normal condition, and may have no cessation of symptoms.

Are chronicity and periodicity peculiar to ulcer of the stomach? We find in gall-bladder disease, appendiceal colics, and many general diseases, this chronicity and this periodicity. Gall-stone and appendiceal attacks come irregularly, increasing in severity as attacks multiply. They appear and disappear suddenly, with the cause often as obscure as in ulcer. The so-called cure in each is only a part of the round of trouble. It is (1) the character of the attack, and (2) the peculiar manifestation of the separate accompanying symptoms that call for consideration in differentiation.

Let us consider the symptoms which accompany an attack of gastric ulcer; first, pain—this is the most constant symptom, in the absence of which some clinicians say we must not diagnose ulcer. Pain is usually epigastric and its field of radiation is limited. It may be burning, gnawing, lancinating, mild, or extremely severe, depending on location, extent and depth of ulceration, amount and degree of acidity, and the persistence of accompanying spasm. Gas is usually present and varies from mild pressure to most extreme annoyance; sour eructations, waterbrash, vomiting of more or less intensely sour, acrid, bitter-burning fluid, which may be mixed with food, are usual symptoms. Some or all of these symptoms accompany an attack, and each may be characteristic of ulcer,

when considered in its peculiar relation to time. May not any or all of these symptoms be present in gall-stone trouble or appendiceal attacks? All three—ulcer, gall-stones, appendicitis—have pain which may be epigastric only, with any degree of severity. There may be gas, vomiting, sour eructations, and acidity of the stomach complained of in all. Then chronicity, periodicity, pain, vomiting, and gas are not of themselves characteristic of gastric ulcer. It is not the location of the pain that tells the story; it is not the kind of pain nor its severity that points the way; it is not the presence of all nor the severity of the several accompanying symptoms that makes pain, but it is (1) the *time* of pain or other symptoms, (2) the *regularity* of pain and other symptoms, and (3) the *means* by which the pain or other symptoms are relieved, that give the differential characteristics to gastric ulcer.

During a period of attack in gastric ulcer—an attack the duration of which may be days or weeks—the patient complains more or less severely of pain, gas, vomiting, sour eructations, heartburn, and sour stomach; he will say it follows meals, but it will be often found more exact to say before meals. Usually one to five hours after a hearty meal the symptoms return, increasing in intensity until vomiting or irrigation has removed the acrid, acid material, or it has been neutralized by soda, or, as is more usual, until food is again taken. More or less complete ease follows food and drink; the heartier the meal, the more pronounced and prolonged the comfort. Especially is this noticed early in the history, and when the ulcer is closely pyloric. This train of symptoms repeats daily during the period of attack, with certain regularity after meals. The time after food varies but little for different individuals; indeed, is peculiarly exact for each one. Just as surely and regularly as these symptoms present themselves they are controlled by food, drink, alkalies, vomiting, or irrigation, until complications have changed the character of the disease. This peculiar cycle within the cycle is the characteristic of ulcer. Pain is the most constant factor, but ulcer may be present without pain. If gas, vomiting, distress, or sour stomach is present, and appears and disappears with characteristic regularity before meals and after meals, then

ulcer should be strongly suspected, even in the absence of pain. This type of symptomatology may be approached in hyperacidity, hypersecretion, some appendiceal conditions and the like, but there is no pathologic condition that closely follows this train of symptoms except ulcer of the pyloric end of the stomach. We believe that of all pathologic conditions that approach pathognomonic symptoms none more closely reaches that rank than does uncomplicated ulcer at the gastric outlet.

These pathognomonic symptoms lose force if the position of the ulcer be cardiac, or on the greater curvature near the fundus; the symptoms then are usually quite immediate. In end conditions as—(1) wide destruction, (2) hour-glass stomach, (3) extensive saddle ulcers, (4) perforations and adhesions, and (5) in stenosis, there is a persistency of symptoms developed and the peculiar differential type is lost. There is pain, often severe, quite continuous, and it not only does not yield to food as before, but it is increased immediately, or nearly so, by it. Vomiting becomes irregular and more intense, though perhaps less frequent. The quantity increases and may be exceedingly acid and contain remnants of former meals. Gas appears at any time or all the time, and is often distressing. The patient finds ease through careful diet, or finds the greatest comfort when the stomach is empty, rather than when filled. When these complicated pathologic conditions exist, our difficulties are multiplied, because this latter group of symptoms is not peculiar to primary ulcer lesions. It is, however, common to its complications, to chronic gall-stone cases, to cancer of the stomach, chronic appendicitis, pancreatitis, angina pectoris, kidney lesions, and in many general systemic diseases. Therefore, in order to make a differential diagnosis one should turn back to the carefully determined early history.

Complications.—Perforation is not infrequent and is acute or chronic. The former is less often seen and, when the anterior wall is the seat of perforation, untreated cases show a large mortality. Posterior perforations find protection and oftener become chronic. In acute perforations the pain is intense and calls for large doses of morphin, which may fail to stay the pain. These perforations

simulate acute gall-bladder infections or perforations, and may be mistaken for acute appendiceal attacks. The early pain is often near McBurney's point and will mislead the diagnostician if the examination be cursory.

Chronic perforation is frequent, and causes adhesions to neighboring organs, reduces the motility of the stomach, which, in turn, decreases motor power and increases secretion. This increased secretion adds to the obstruction by causing pyloric spasm, while the spasm again heightens acid secretion, increases the pain, and threatens deeper ulceration. This action and reaction increase difficulties in diagnosis, as well as in treatment. These chronic perforations develop chronic symptoms, and each perforation may give us sudden, sharp attacks of peritonitis. When the ulcer is posterior, these attacks are so closely allied to chronic gall-stone colics that present symptoms alone will not furnish means of diagnosis.

Cicatricial formations are the commonest complications, and cover obstruction, hour-glass stomachs, and other deformities. As a rule, obstruction is not difficult to establish. The usual symptoms of ulcer increase and become chronic. Emaciation and constipation are present. Vomiting of delayed food masses or remnants found at test-meal are usually conclusive evidence. Hour-glass stomach and other deformities, due to adhesions, contractures, and band formation, have chronic symptoms, and, like pyloric stenosis, produce retention, stagnation, and obstruction, but the symptoms are not characteristic. In patients with thin-walled stomachs the outline of the stomach may be seen upon inflation, and occasionally a diagnosis made. The vomitus may contain food at first, then become clear, later food particles appear, though no food be taken during the period of attack; or the cardiac cavity may be thoroughly irrigated, clear water returned, and then suddenly food particles appear. Again, the splashing sound noticed by Jaworski may show fluid in the stomach which cannot be withdrawn because it is in the pyloric cavity. We find slow progress in the diagnosis of the actual underlying condition, but the chronicity and serious phases point directly to surgical interference, which should clear up the diagnostic difficulty and give gastric relief.

Hemorrhage is not so frequent as formerly thought; at least, hemorrhage that calls for radical interference. Large areas continually oozing lead to anemia, and with the serious and chronic accompanying symptoms we are not greatly delayed in deciding the condition. Bleedings that are copious bring sudden pallor and anemia, weakness, fainting, and great shock—quantities may be vomited and tarry stools later be present. It is often easy, at other times it may be difficult, to diagnose this condition.

As a complication, we would lay most stress upon malignant degeneration. Not because it calls for surgical relief oftener than does obstruction, malformation, or perforation, but because *it is the fruitful soil for cancer implantation*; when cancer is once implanted, the cure has been proved most difficult, partly, no doubt, because diagnosis is slow. If we would conquer in this dreadful battle against cancer, we must enter the field of ulcer, and attempt to cure cancer in that stage when it is not cancer—but ulcer. Latency of both ulcer and cancer is to-day a great obstacle to their proper handling. Ulcer may be destructive, its first symptom sudden hemorrhage, perforation or obstruction—or malignancy may have been long implanted, and its first pronounced symptom be manifest only when tumor or dissemination has disclosed a hopeless condition. In our histories we find about one-half of the cancer cases with a long preceding ulcer history, and about 71 per cent. of excised portions when examined microscopically show implantation on an old ulcer scar. Therefore, when definite and obstinate gastric symptoms obtain, we should not be slow to advise treatment which not only offers general relief, but greatly mitigates the grave danger of cancer.

In *differential diagnosis* we shall touch but three of the many conditions that call for attention: cancer, chronic appendicitis, and gall-stones. In our round of differential diagnosis we should not forget pancreatic stone, kidney lesions, angina pectoris, gastric crises, intestinal colics, etc., as well as many general systemic diseases, like pernicious anemia and Bright's disease, that may carry symptoms closely related to ulcer.

Cancer.—In eliciting histories from those suffering from gastric

cancer, we have found them to fall into three classes: first, those in which the disease seemed to appear suddenly in the enjoyment of perfect health; second, those in whom an attack or attacks in earlier years are definitely stated, and who, for years, have been well until sudden grave symptoms (as in Class 1) threaten; and, third, those who for years have had typical attacks of chronic gastric ulcer. In the first and second classes we may find tumor, an advanced pathology, and symptoms of chronicity suddenly and very acutely developed. We may find those cases whose only complaint is a diffident weak feeling, and who are chiefly concerned because an epigastric tumor has been discovered. Others complain of languor, weakness, loss of appetite, and emaciation, and nothing on physical examination is revealed; the test-meal may be of value here. We feel sure that, however great the difficulties met here in reaching a diagnosis, they are not less than in Class 3, where ulcer has been apparent for years.

Some patients are weak, emaciated, and cachectic when ulcer is the only lesion. A palpable tumor and vomiting of delayed food, poorly macerated, with coffee-ground appearance, may be present and ulcer still be the lesion—but tumors of the stomach are usually cancer. When cancer has once fastened itself upon the stomach, the course is short and steadily downward, and remissions are seldom experienced. In cancer, so-called pyrosis may increase in time and amount, but loses its acidity; regurgitation day or night is also increased in amount and likewise loses its acidity. Vomiting is often more delayed, more copious, oftener blood-mixed, and gives a strange and great relief, though rarely so complete as in ulcer. Vomiting and nausea are more often excited by liquid food; gas and bloating become more chronic and distressing; appetite is lessened and finally lost or a disgust for food is felt. Emaciation comes on rapidly; pallor, anemia, and weakness hasten; loss of power is marked, desire for activity is wanting, and a great languor is felt. Food, instead of giving relief, is quite apt to produce immediate pain, which may be acute, but oftener is dull, sickening, almost indescribable, or a strange distress not related to food is common and continuous. With all this there is a mental

depression and a consciousness of approaching evil. This mental attitude is the great factor that gives to the face the expression that so often marks the malignant sufferer. No symptom or symptoms seem sufficient by which to diagnose cancer of the stomach—the facies, the general appearance, the mental attitude, the physical condition, the direct gastric symptom, all form a composite picture, a glance at which may make the diagnosis.

Chronic recurrent appendicitis is the type that simulates chronic ulcer of the stomach. There are distinct prolonged attacks. Pain is not referred to McBurney's point, and often no appendiceal tenderness can be elicited. There is no fever, no tumor, no symptoms that accompany the usual attack of appendicitis except those directly referred to the stomach. There can be little doubt that many of the chronic gastric symptoms are reflex, due to pyloric spasm. The pain may be purely reflex or it may be directly due to the pyloric spasm and the accompanying stomach reaction. Pain, vomiting, gas, increased secretion, and sour eructations all follow pyloric spasm, whatever its origin, and the stomach reactions, whether due to pyloric spasm or obstruction, must give the same symptoms. So we have in spasm due to appendicitis reverse peristalsis and the usual chronic stomach accompaniments of ulcer. As in complicated chronic ulcer, food soon increases the trouble and rarely gives direct and decided relief, while sour foods quite often offend. Quite a degree of invalidism may result. The symptoms, though scarcely as persistent and severe as in chronic complicated ulcer, give quite the same picture. If the early, clear history of peptic ulcer is lacking and we can get no history of typical appendicitis, and if all local appendiceal symptoms are absent, we are exceedingly disposed to diagnose gastric ulcer.

Gall-stones.—The great majority of biliary attacks are easily diagnosed. The symptoms appear in decided attacks of short duration (except chronic), usually moments or hours. Intermissions of days, months, or years of perfect health are the rule in uncomplicated cases. The attack comes suddenly, often without the slightest warning. The abrupt cessation of the attack is as characteristic as is this suddenness of onset, perhaps during the height of

pain, followed by immediate return to quite normal health. Pain is the great overshadowing symptom. It is epigastric, with radiation to the right costal border, and to the right scapular region, or the chest and abdomen may be one great area of pain. It is lancinating, boring, severe; spasm of the diaphragm (dyspnea) is present and marked. The pain appears without any regularity as to time—day or night, to-day, next year, before meals, after meals, no meals. It is wholly independent of and not caused by food, neither is it relieved by food, and the patient rarely places a relation between food and pain. Gas is present and by pressure intensifies pain, for belching brings a degree of relief; but the bloated, distended, almost bursting sensation that so many experience is due chiefly to the character of the pain and its field of radiation, rather than to the presence and pressure of gas itself. Vomiting, often present, may bring relief, but not with the certainty that it does in ulcer. It comes during the height of the attack, may be somewhat prolonged, consists of a green, bitter fluid, not copious, unless soon following a meal. Jaundice is more frequent (25 per cent.) in gall-stones, and hemorrhage (25 per cent.) in ulcer; constipation is common in ulcer, while in gall-bladder disease the bowels are rarely disturbed. Nutrition fails during an active ulcer period—while in gall-stones nutrition rarely suffers until duct complications and pancreatitis supervene.

We may find almost insuperable barriers when we attempt to differentiate between some chronic gall-bladder conditions and gastric ulcer with chronic perforations. Especially is this difficulty increased if, in ulcer, the perforation is posterior, when the pain radiates into the back. In both we may have chronic symptoms present—pain, vomiting, burning, distress, sour eructations, poor appetite, and emaciation. These symptoms are usually recognized as those of gall-stones, because of pain radiation, which is the only characteristic in the whole syndrome. There is another class of ulcer cases quite impossible to place correctly; it is usually the duodenal or pyloric type. The only symptom complained of is sudden, severe, short epigastric attacks of pain, more often without radiation, occasionally to the back. Recovery from pain which is

due to chronic perforation or spasm comes rapidly and is complete. The attack is typical only of gall-stones. No other rational pre-operative diagnosis is possible. In the first group the early history promises solution. In the latter group surgery must tell, or delay will develop the characteristic symptoms. Until broader methods of diagnosis are evolved we must too often, in both gall-stones and ulcer, rest satisfied with a surgical diagnosis.

DIFFERENTIAL DIAGNOSIS OF GALL-STONES, ULCER AND CANCER OF THE STOMACH *

By CHRISTOPHER GRAHAM

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Gall-bladder disease has its peculiar types of digestive disturbances. We would distinguish four stages, based on the degree of symptoms developed in the history. The first is exemplified by those cases of mild disturbance, usually gastric and often lightly considered by the patient, and even more lightly by the physician. These patients have slight attacks of distress with gas and upward pressure, coming often soon after food, or at irregular times, often with sudden onset of short duration and eased by belching or, perhaps, slight vomiting or regurgitation and slipping away almost unnoticed and without treatment, though many and various measures may get credit for what is in reality a natural return to health. These sudden, irregular, mild "dyspeptic" attacks are quite as typical of gall-bladder disturbances as are the severe so-called "typical attacks" which, as a rule, supplant the mild.

The second stage of the disease is seen in those cases with more or less prolonged dull (mild or quite severe) pain in epigastrium, right arch, or whole liver area. This pain may be increased by food, exertion, or motion. Deep respiration gives pain, and when located posteriorly the trouble may be called pleurisy. These patients pass through prolonged, steady attacks, their distress may alternate with ease, and comparatively good or excellent health may be enjoyed for a time. During an attack dyspeptic symptoms are prone to be present, and but for their irregularity, as compared

* Read in the Section on Surgery, Medical Society of the State of Pennsylvania, Philadelphia Session, September 29, 1909. (Reprinted from "The Pennsylvania Medical Journal," Nov., 1909.)

to ulcer, one might too frequently consider the possibility of a gastric lesion.

In the third class of cases is to be found the greatest number upon whom the correct diagnosis falls, and in this class surgery finds its greatest activity. Here we have the so-called "typical gall-stone attack," sudden, severe epigastric pain with radiation to the right arch (at times to the left) through to back or scapular region, spasm of the diaphragm, upward pressure, gas, nausea, vomiting, and, after a longer or shorter terrific attack, comes sudden cessation of symptoms, and, until complications have obtained, an almost immediate return to perfect health. Sudden onset and sudden cessation without apparent cause or any treatment are quite peculiar to gall-stone disease when no complications are present. These attacks come irregularly, night or day, and though often called acute indigestion, acute gastritis, gastralgia, neuralgia of the stomach, and other equally foreign names, they more often bear no relation to food, and lack all the fundamental symptoms of ulcer.

The fourth condition is that of chronic gall-bladder trouble with adhesions, duct obstruction, perforation, contractions, and duct infections with pancreatitis. In this class chronic gastric disturbances often predominate, and the picture is so closely related to chronic ulcer with complications that a differential diagnosis cannot be clearly made, if present symptoms only are considered. At this stage the key to diagnosis depends upon the development of the early history. However, the chief end is obtained when the necessity for surgery is realized, and the patient is sent to the surgeon for relief with a surgical diagnosis of upper abdominal trouble.

Chronic ulcer of the stomach has a definite, clear-cut, and regular symptomatology, and we will discuss this as the purest type of indigestion. Ulcers of the duodenum and pyloric end of the stomach give symptoms that, as a rule, vary in degree only, and often so little that one usually finds greater trouble in differentiation than in making the ulcer diagnosis. However, as the lesion recedes toward the cardia, the clear-cut symptoms lessen and their peculiar pathognomonic character may be lost when the ulcer is clearly away from the pyloric end. First let us note that the histories of

those who come to operation cover years of complaint, and that for much of the time the periods of attack and periods of freedom from symptoms alternate. Early in the history the appetite remains good, nutrition does not fail, and food brings immediate relief from symptoms. The pain, distress, gas, sour eructations, nausea, and vomiting return one to four hours after meals; the heartier the meal, the more marked and prolonged the relief. During the period of attack this precise relief of symptoms by food or drink, and regular return one to four hours later, are peculiarly characteristic, and prevail until complications have arisen that seriously interfere with the gastric function. Another stage of the trouble may be considered as beginning after many periods of attack; the peculiar, characteristic symptom-type remains, but is less definite. The attacks are more severe and prolonged, appetite may fail or food is not taken because of pain, distress, gas, vomiting, sour eructations, and burning stomach; food and drinks relieve, but the time of relief is shortened and the later pain is increased. Vomiting may replace eructations, and give relief, as does irrigation of the stomach. Nutrition decreases, not so often because of lessened appetite as because of insufficient prescribed diet or fear of late, distressing symptoms. Ease comes for a time from food or drinks, vomiting, irrigation, and alkalies, and pain relapses when the acrid contents of the stomach return. It is not the chronicity or the periodicity that is peculiar, nor the degree or location of the pain, neither the vomiting, gas, sour eructations, nor sour, burning stomach; these are common to all chronic dyspeptic types of trouble, gall-stones, appendicitis, cancer, etc. The characteristic point is the time the symptoms appear, and their regularity after meals; and the equally ready control of symptoms by food, vomiting, irrigation, etc. This regularity and control of symptoms, meal after meal and day after day during the period of attack, is scarcely approached by any other organic or functional disorder. Later, when complications have appeared, the symptoms change. Food may not give ease, but rather increase the distress, which is often more nearly continuous. There are no periods of real relief. Vomiting occurs perhaps less often, and is more copious and gives

partial relief. Appetite and nutrition fail. The early, regular, characteristic history gives us the key to the diagnosis when we are in the presence of the chronic, complicated stage of ulcer development.

The clinical histories of cancer of the stomach seem to fall into three groups: First, those preceded by a clear and prolonged typical ulcer history; second, those in which years before the recent continuous attack, more or less stomach disturbance had been complained of, but in which there had been a long period (years) of perfect freedom from symptoms; third, those in which there can be obtained no record of disturbance until the sudden burst of malignant signs. The second group should gain at the expense of the third through careful history-taking. At no stage in its development does cancer of the stomach give us a characteristic run of symptoms of its own, as will be found in duodenal and pyloric ulcers and gall-stones. The diagnosis is therefore much more difficult to make.

In the first group, which includes about 50 per cent. of all cases, there is the long-preceding, typical ulcer history, and this may gradually shade down and become less and less typical until it approaches the character of complicated ulcer (obstruction, adhesions, perforation, etc.), at which time all typical signs are lost and we have the almost constant symptoms common to complicated ulcer, chronic gall-stones, chronic appendicitis, and, in a great measure, those of carcinoma of the stomach also. It is quite impossible to determine when the degeneration begins, because the characteristic ulcer symptoms lessen, and gradually assume the complicated type. Appetite may fail, great waste be present, hemorrhage marked, cachexia advanced, free hydrochloric acid absent, and yet ulcer may be the only lesion found at operation. It is in this group of cases that we find the greatest obstacles to an accurate diagnosis. But such late conditions should not be considered medical, and, at the hands of surgeons, the patient should get relief even if the diagnosis be at fault.

In the second and third groups the diagnosis may be oftener and more easily made at the first examination than in the first group.

perhaps because the cancer, developing on the latent ulcer, causes symptoms to appear only when great invasion has taken place, and the patient often presents himself after some lapse of time when the malignant change is so far advanced that little is left to be recommended but palliative remedial measures. In these cases we usually find rapid wasting, cachexia, great loss of strength, a peculiar weakness, loss of appetite, pain (though distress, even mild distress, often covers this symptom), tumor, perhaps vomiting with blood and lack of free hydrochloric acid in the stomach contents. The picture is clear and the diagnosis rarely missed. On the other hand, we must be ready to make a tentative diagnosis with one or few signs. Some patients come because of a tumor, some because of weakness and loss of appetite, others only because of wasting and loss of strength. The test-meal here reaches its greatest efficiency.

Usually, however, the patients of the last two groups have tumors and other symptoms sufficient at the time of presentation to meet the requirements of diagnosis rather easily, but they are generally poor subjects for comforting surgical statistics. Exploration, inoperable carcinoma with wide gland infection, are too often the only annotations at operation.

Ulcer is the great soil upon which cancer is engrafted. When ulcer is latent, cancer may develop, and no sign be given until such wide destruction and infection are present that surgery is worse than useless. The general picture presented by the patient is often valuable. Wasting and weakness are complaints, and lack of appetite fails to account for all. The picture of cachexia is present, and bears little relation to the wasted appearance of ulcer starvation. Depression seems to be an early sign. The facial expression is significant, with pallor about the eyes, nose, and mouth and a drawn, pinched look. There is a silent fear, with apprehension of grave trouble. This, with depression of spirits, tardy confession of symptoms, slow and weakened movements, and listlessness will often leave little doubt as to the presence of cancer.

Pain, a common symptom, is perhaps not so often noted as in ulcer. It is epigastric, rarely acute, except when perforative, a dull,

sickening, indescribable pain; or a strange distress supplants the decided pain-spells of ulcer. It is not as closely related to food, though modified by it. It is a continuous pain or distress, immediately intensified by foods or drinks, though, in a few instances, if no obstruction be present, a short relief does follow food if the hydrochloric acid continues high or abstinence has been practised for a time. The acute pain of ulcer is gone, the time lengthens almost to continuousness, and, as a rule, it is a dull, sickening, distressing, depressing nervous ache. Pain, unlike that in ulcer, is not controlled by foods, but careful diet, bland liquids, or abstinence reduces discomfort to a minimum. Subjective localization of pain is not dependable in ulcer, and is less so in cancer; epigastric distress only is the usual localization. Tenderness is not a great diagnostic help in either ulcer or cancer. Vomiting gives relief to the distressing symptoms in cancer, as does lavage when carefully practised.

A good appetite may remain late in some instances, but a decrease of it is usual early, and later, poor appetite is a rule. Fear of food comes correspondingly earlier than in ulcer, and is often a factor of lessened food intake rather early in the degenerating process. A small amount of food seems to fill the patient and gives a bloated, disagreeable oppression. An utter distaste for food is occasionally present, even when early symptoms are noted, and later it is not infrequent. Bland foods add least to the constant trouble. Careful diet is practised, and it does reduce to a minimum the distress.

Nutrition fails early; wasting follows rapidly and surely, though often more rapidly than lack of food would indicate (cancer poisoning). This rapid loss brings a dry skin, a pinched and wrinkled appearance. Paleness follows the emaciation, and blood loss completes the picture, which is cancer.

Vomiting is usually a prominent symptom and increases as the disease progresses. As compared to ulcer, it is more irregular and more abundant, more frequently rancid, foul, and obnoxious, and there is a longer interval between attacks of vomiting. Nausea and vomiting may be present when no food is in the stomach, and both conditions are easily excited by food and drink. Blood, bright or

coffee grounds in character, is frequently found in the vomitus. There is less effort in cancer vomiting, and though the patient feels wonderful relief, it is not always complete. The characteristic of cancer vomiting is its irregular delayed type, with poorly macerated, undigested masses of food, and large quantities of foul vomitus frequently containing blood. All this may be present and the outlet may not be badly stenosed (motor power is poor as a result of cancer infiltration). Eructations of liquids of a low acid content day or night are frequent means of some relief.

Gas is usually annoying, is increased over that in ulcer, is quite continuous, though there are irregular periods of intense belching, generally soon after food. Especially is this true late when diet is not strictly followed. More frequently in cancer than in ulcer the gas has a foul, offensive odor, and the breath is bad, in contrast to the bland or sour breath of gastric ulcer.

As in ulcer, the bowels are constipated, but blood is more often present in the stools. Tumor is found in from 60 to 70 per cent. of patients with cancer as they present themselves for relief, while in ulcer not more than 5 per cent. show tumor. The test-meal has its pointings: Lessened hydrochloric acid, increased blood, food remnants more constant, lactic and fatty acids oftener present. Therefore, the test-meal should be considered, but it should be interpreted in the light of a careful clinical history.

SUMMARY

In gall-stones the general health does not suffer until complications are present. The course of ulcer is prolonged and fluctuating—periods of trouble and periods of perfect or partial health; but in cancer it is short and steadily downward.

Pain in gall-stones is irregular in time, of sudden onset, and of severe, short duration, abrupt cessation, radiates to right arch and back, and is independent of food. In ulcer pain is usually clear-cut, in spells, regular in time, and eased by food, to again reappear in from two to four hours. In cancer the pain is continuous, dull, depressing, and not only is not controlled by food, etc., but is immediately increased by it.

In gall-stones the vomiting is less a factor in diagnosis. It is small in amount unless the attack is soon after a meal. It is usually bitter, sour bile, and is not so often a means of relief, nor does it play any part in the state of nutrition (except during late complications). In ulcer vomiting is as regular as is pain, and consists of sour material, not offensive, and, if abundant, is often excessive in liquids. It brings complete relief and is controlled as is the pain. Vomiting in cancer is irregular, and the vomitus large in quantity, of poorly macerated food mass. It is foul, often blood-stained, and brings great though rarely complete ease.

In gall-stones gas is troublesome only at the time of the colic; it may be excessive and give the distressing upward pressure, but immediately disappears on cessation of cramps. Perhaps this sensation is due less to gas than to the radiation of pain. In ulcer gas is a symptom at a time when other symptoms are present, and is controlled in the same manner that the other symptoms are controlled. In cancer the gas is continuous and increased in amount, with periods of great increase usually soon following food.

Blood is rare in gall-stones, in ulcer it is quite rare (in about one-fourth of the cases), but in cancer it is common (two-thirds of the cases), both by stomach test and fecal examination.

In gall-stones the patient is normal physically, save when there are late complications with pancreatic disturbance. In ulcer the patient is hopeful and active, though often reduced in nutrition. In cancer the patient is depressed, languid, weakened, tired, melancholy, discouraged, pale, and perhaps cachectic.

The diagnosis of gall-stones is met with considerable satisfaction. That of peptic ulcer is perhaps less clearly defined, but is rapidly approaching a degree of certainty. Both in gall-stones and in ulcer ignorance, neglect, or wilful delay find some excuse because the consequences are not so plainly demonstrable, and delay is not so often fatal. The diagnosis of cancer of the stomach is extremely difficult to make in that early stage when surgery, the only means of relief, offers a hope of cure, and when delay is fatal. Ignorance on the part of the physician is unpardonable; neglect, almost criminal. The physician's position is harassing; the patient's, perilous.

Though late in his diagnosis, either because of insuperable circumstances, lack of knowledge, or unpardonable neglect, the internist has met his responsibility, at least in a small measure, when he places his patient with gall-stones, ulcer, or suspected gastric cancer in the hands of a competent surgeon; but the surgeon's responsibility does not cease with exploration or gastro-enterostomy alone, because careful resection is necessary when we are in the presence of cancer or any suspicious ulcerous lesion.

DIFFERENTIAL DIAGNOSIS OF DISEASES CAUSING GASTRIC DISTURBANCE *

By CHRISTOPHER GRAHAM

Peptic ulcers furnish the typical dyspeptic syndrome. Duodenal and pyloric ulcers give a train of symptoms that is peculiarly characteristic, almost pathognomonic. Histories of patients at the surgical clinics show (1) that most of them have suffered more or less for years; (2) that during the years alternating periods of attack and perfect or partial health are clearly defined. The attacks come more often in the spring and fall, especially early, but they may be irregular, coming and going quite without known cause. During an attack pain, distress, burning, vomiting, gas, and pyrosis—one or all may be present, and always at a time peculiarly regular for the patient. Two to four hours after meals the patient feels the return of symptoms, which at their height may quite prostrate him. He has a hungry, burning, sour feeling in stomach; pain, distress, gas, and sour vomiting may be present. Food taken gives ease. Anything that engages the acid and neutralizes it or removes it brings comfort. Early hearty meals give most relief. What quiets pain, quiets all symptoms. This regular return of symptoms two to four hours after food, and their control by food, drink, alkalies, vomiting, etc., meal after meal, day by day, during the attack, is peculiar to peptic ulcer only. When complications have arisen, the symptoms may be continuous, and so changed that they may be common to many diseases. To get at the diagnosis properly at this late stage the early history is necessary.

* Read at the forty-first annual meeting of the Minnesota State Medical Association, held at Winona, Oct. 14 and 15, 1909. (Reprinted from "The Journal of the Minnesota State Medical Association and the Northwestern Lancet," April 1, 1910.)

Cancer.—In developing histories from those suffering from gastric cancer, we have found them to fall into three classes: first, those in which the disease seemed to appear suddenly during the enjoyment of perfect health; second, those in whom an attack or attacks in earlier years are definitely stated, and who, for years, have been well until sudden grave symptoms (as in Class 1) threaten; and, third, those who for years had typical attacks of chronic gastric ulcer. In the first and second classes we may find tumor, advanced lesions, and symptoms of previous chronicity suddenly and very acutely developed. We may find those cases whose only complaint is a diffident weak feeling, and who are chiefly concerned because an epigastric tumor has been discovered. Others complain of languor, weakness, loss of appetite, and emaciation; and on physical examination nothing is revealed. The test-meal is of value here. We feel sure that, however great the difficulties here met with in reaching a diagnosis, they are less than in Class 3, where ulcer has been apparent for years. Some patients are weak, emaciated, and cachectic when ulcer is the only lesion. A palpable tumor and vomiting of delayed food, poorly macerated, with coffee-ground appearance, may be present, and ulcer still be the lesion; but tumors of the stomach are usually cancer (95 per cent.). When cancer has once fastened itself upon the stomach, the course is short and steadily downward, and remissions are seldom experienced. Pain in cancer is quite a constant symptom, though less often noted than in ulcer. It is less acute, more continuous, a dull, strange, depressing ache, and usually immediately intensified by ingested material. It is epigastric, and tender areas are not common. In cancer so-called "pyrosis" may increase in time and amount, but loses its acidity. Regurgitation, day or night, is also increased in amount and likewise loses its acidity. Vomiting is often more delayed, more copious, oftener blood-mixed, and gives a peculiar and great relief, though rarely so complete as in ulcer. Vomiting and nausea are more often excited by liquid food; gas and bloating become more chronic and distressing; appetite is lessened and finally lost, or a disgust for food is felt. Emaciation comes on rapidly; pallor, anemia, and weakness hasten; loss of

power is marked; desire for activity is wanting; and a great languor is felt. Food, instead of giving relief, is quite apt to produce immediate pain, which may be acute, but oftener is dull, sickening, almost indescribable, or a strange distress, not related to food, is common and continuous. With all this there is a mental depression, as though a consciousness of impending evil. This mental attitude is the great factor that gives to the face the expression that so often marks the patient who suffers from malignant disease. No symptom or symptoms seem sufficient by which to diagnose cancer of the stomach: the facies, the general appearance, the mental attitude, the physical condition, the direct gastric symptoms—all form a composite picture, a glance at which may make the diagnosis.

Gall-stones.—In gall-bladder disturbance there are, first, those cases of mild disturbance, usually gastric and often lightly considered by the patient and even more lightly by the physician. These are light attacks of distress, gas, upward pressure, coming often soon after food or at irregular times, often of sudden onset, short duration, eased by belching or perhaps slight vomiting, regurgitation, or slipping away almost unnoticed and without treatment, though many and various measures may get credit for natural return to health. These sudden, irregular, mild “dyspeptic” attacks are quite as typical of gall-bladder disturbance as are the severe typical attacks which, as a rule, supplant the mild. Second—There is another set of cases with more or less prolonged, dull (mild or quite severe) pain in the epigastric area, right arch, or whole liver-area. This pain may be increased by food, exertion, or motion; deep respiration gives pain, and when entirely located posteriorly the trouble may be called pleurisy. These patients pass through prolonged steady attacks, then ease may alternate with distress, and comparative or excellent health be enjoyed for a time. During an attack dyspeptic symptoms are prone to be present, and but for this irregularity, as compared to ulcer, one might often consider gastric lesions. Third—In this class is to be found the great number upon whom the correct diagnosis falls, and in this class surgery finds its greatest activity and rewards its

adherents by giving great relief and lengthened days. Here we have the so-called typical gall-stone attack—sudden severe epigastric pain, with radiation to the right arch (at times to the left) and through to the back or the scapular region, spasm of the diaphragm, upward pressure, gas, nausea, vomiting, and after a longer or shorter terrific spell comes sudden cessation of symptoms, and, until complications have obtained, almost immediate return to perfect health. A sudden onset and sudden cessation without apparent cause or any treatment, are quite peculiar to gall-stone disease when no complications are present. These attacks come irregularly, night or day, and often bear no relation to food, though often called acute indigestion, gastralgia, neuralgia of stomach, and other equally erroneous names. The fourth condition is that of chronic gall-bladder trouble—adhesions, duct-obstruction, perforation, contractions, duct-infections with pancreatitis. Often in this class chronic gastric disturbances predominate, and the picture is so closely related to chronic ulcer with complications that a differential diagnosis cannot be clearly made if only present symptoms are considered. At this stage the key to diagnosis depends on the development of the early history.

Chronic recurring appendicitis is the type that usually gives stomach symptoms. There is no appendiceal tenderness, no pain at McBurney's point, no fever, no tumor, no symptoms that usually mark appendicitis, except those referred to the stomach. There may be pain, gas, vomiting, sour stomach, and pyrosis, but when compared with peptic ulcer they are irregular, and when gall-stones are considered the attack is too prolonged. The whole train of symptoms is caused more often immediately by food, but this meal gives one effect and the next meal another. There is no regularity, meal after meal, as in chronic ulcer, and rarely does food give ease. Pain is often a queer, rather continuous distress, which is epigastric or indefinitely abdominal, which the patient describes as epigastric. There is no clean-cut day-by-day repetition, as in ulcer, and no attacks like gall-stones of definite location of pain. Nausea, distress, a gassy, bloated condition covers the bad feeling of more cases of chronic appendicitis than of chronic

ulcer or gall-stones. Exertion is a factor in appendicitis, and sufferers from it are seemingly often unable to work. Pain may be epigastric only, but often indefinitely of the epigastric and abdominal regions or low gall-bladder or high appendix areas. If we have dyspeptic attacks with epigastric pain and radiation to the umbilicus or lower abdomen, consider, first, appendiceal disturbance.

Syphilis, when it attacks the stomach or liver, may clearly simulate ulcer of the stomach or gall-stones, and when quite advanced, the pain, cachexia, and vomiting may lead to a strong suspicion of cancer of the stomach. The vomiting of crisis may mislead; however, the attacks are peculiarly sudden, the vomiting is irregular, often soon follows introduction of food to the stomach, but appears if total abstinence is practised. Perhaps little pain (nausea), not so often sour stomach, no hunger-pain, no food relief, or other characteristic of peptic ulcer is present. There is usually not so much emaciation, because attacks are not, as a rule, so prolonged. The attacks cease as abruptly as they begin, and no signs of trouble remain. No regularity of ulcer; no picture of gall-stones. A history of specific infection, shooting pains of a general character, and other specific signs will cause the physician to hesitate. Specific treatment often clears up the diagnosis.

Many patients with pulmonary tuberculosis will present themselves with a diagnosis of stomach trouble, not a few of them fearing ulcer or cancer. Anorexia, food-pain, vomiting, emaciation, and cachexia are present, and hydrochloric acid is absent. An examination reveals irregular fever, cough, bacilli, lung complications, or other tuberculosis foci; and the clinician should not remain long in doubt concerning the correct diagnosis. Tuberculosis of the intestines (colon) often gives dyspeptic symptoms, and careful examination often leaves one unable to definitely say whether appendicitis, gall-stones, or purely stomach disturbance is present.

Bright's disease will often confuse the physician. Loss of appetite, emaciation, anemia, vomiting, and stomach analysis will closely follow the ulcer or cancer type of stomach trouble. Re-

peated examinations of the urine may be necessary. A history of increased frequency, together with the condition of the heart and blood-vessels, will usually clear up the diagnosis.

Pernicious anemia is often most difficult to differentiate from ulcer and cancer. Unless the blood-findings are positive one is often at a loss in deciding. There may be lack of appetite in both. Dyspeptic symptoms, but not the dislike of food, come with anemia. We do not usually find the pain and vomiting of cancer. In cancer and anemia there may be pain, shortness of breath, and palpitation on exertion, which conditions are more marked in anemia than in cancer. Rest gives perfect physical ease in anemia, while in cancer the stomach distress and general weakness do not yield completely to quiet. There is less emaciation in anemia; the skin is more apt to be a lemon color than colorless; there is an oilier "feel" present; and a slight general edema is usually found. Stomach analysis in pernicious anemia is misleading, and if seriously considered, many mistaken diagnoses may be credited to it. The absence of hydrochloric acid and the presence of blood are quite frequent conditions in both. The examination of the blood is invaluable. In anemia the hemoglobin is low, the red count low, and the color-index high. In cancer the hemoglobin test is frequently high, due to dehydration of the blood; and the color-index is not abnormal. Staining the blood, with the discovery of the distinctive cells of anemia, will usually establish the diagnosis. The facial expression is of value. In anemia there are general paleness and icteric tinge—not the excessive paleness about the eyes and nose. There are a slight puffiness of the tissues and a more hopeful expression; emaciation is less marked, and the wrinkled condition, which in cancer adds so much to the picture of cachexia, is wanting.

ULCER OF THE DUODENUM WITH REPORT OF TWO HUNDRED AND SEVENTY-TWO OPERATIONS*

By WILLIAM J. MAYO

Surgical invasion of the upper abdominal region has gradually enabled us to replace theory with facts, and fallacious clinical observations have given way before actual demonstration of diseased conditions.

One of the most striking illustrations of this newer knowledge is the discovery that three-fifths of all gastric and duodenal ulcers are situated in the duodenum. Until within recent years gastric ulcer has been considered the chief lesion, while reference to a duodenal location has been infrequent.

In a paper read before the American Surgical Association, May, 1904, I reported 58 operations for duodenal ulcer, which at that time was 27 per cent. of all the ulcers of the stomach and duodenum on which we had operated.

Two years later, in a paper read before the Surgical Section of the British Medical Association, August, 1906, on "Duodenal Ulcers," our statistics showed about 40 per cent. of ulcers in the duodenum. Since that time more careful investigation places the proportion at above 60 per cent.

In 1906-07 the total number of gastric and duodenal ulcers operated on by C. H. and W. J. Mayo was 193. Of these, 119, or 61.7 per cent., were duodenal, 60, or 31 per cent., gastric, and 14, or 7.3 per cent. of the patients, had a separate ulcer on the stomach and on the duodenum.

* Read in the Section on Surgery and Anatomy of the American Medical Association, at the fifty-ninth annual session, held at Chicago, June, 1908. (Reprinted from "The Journal of the American Medical Association," Aug. 15, 1908, vol. li, pp. 556-558.)

This does not prove that duodenal ulcers are more frequent now than in the past, but rather that they have been confused with gastric ulcer. In other words, we have been talking about gastric ulcer, writing about gastric ulcer, and treating patients for gastric ulcer, when, in the majority of instances, the trouble was primarily in the duodenum and not in the stomach.

There are several reasons why the facts in regard to the relative frequency of gastric and duodenal ulcer have not been brought to light. Until of late our most important source of information was derived from post-mortem examinations, but such data are often misleading, since by the time the lesion had caused death terminal infections and secondary complications had so obscured the field that the situation of the ulcer could not be accurately determined, and it was taken for granted that its location was in the stomach.

The greater number of patients with ulcer of the stomach and duodenum do not die from the disorder itself, but become a prey to intercurrent disease, to which their underfeeding and consequent anemia render them peculiarly liable.

In our earlier work even surgical exploration did not always reveal the truth, and often the location of the ulcer was not accurately established at the time of operation. This is accounted for by the fact that nearly all duodenal ulcers exist in the first inch and a half (ascending part) of the duodenum, and more than one-half extend up to or within three-fourths of an inch of the pylorus, while 20 per cent. of them involve the margin of the stomach at the pyloric ring. Many duodenal ulcers, therefore, were formerly put down as pyloric and consequently classed with the gastric.

Differential diagnosis at the operating table between ulcers of the duodenum and those of the stomach near the pylorus may be difficult, but if careful search is made for the pyloric veins (Fig. 67), their exact location can be quickly detected.

Multiple ulcers of the stomach and duodenum are rare. In only 8.2 per cent. were there separate and distinct ulcers of each organ, although on the mucous membrane opposite an ulcer a second ulcer is often found at the point of contact, which we have, therefore, called the *contact ulcer*.

Total number of operations for duodenal ulcer 272, made on 261 patients. Of these, 77 per cent. were males and 23 per cent. females. The preponderance of male over female is hard to explain, and it is somewhat greater in duodenal than in gastric ulcers.

During 1906-07, 60 patients with gastric ulcers were operated on, of whom 36, or 61 per cent., were males, and 24, or 39 per cent., females. In this connection it is worthy of note that, while nearly four patients out of five with duodenal ulcer were men, the opposite

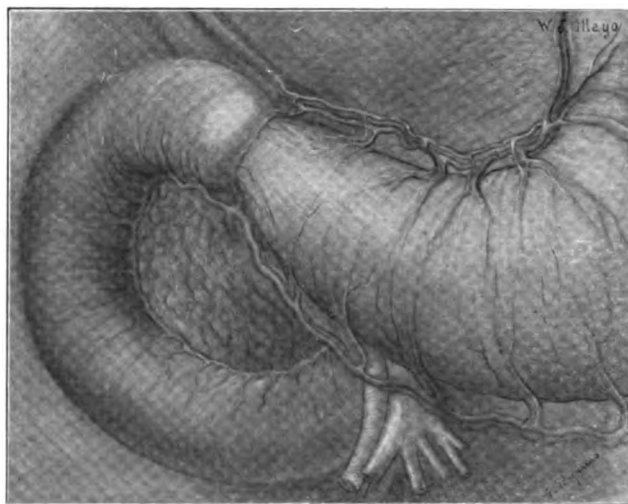


Fig. 67.—The anatomy of the duodenum with special reference (1) to the pyloric veins which accurately locate the pylorus; (2) note the light colored spot on the duodenum just below the pylorus, which may be mistaken for an ulcer when rendered anemic by traction; (3) crossing of the third portion of the duodenum by the superior mesenteric vessels.

was true in gall-stone disease, in which more than four out of five patients were women.

A somewhat careful examination of the living subject leads us to believe that, so far as duodenal ulcer is concerned, mechanics may play a part. The first, or ascending, portion of the duodenum in man seems to ascend a little higher than the average first portion in woman; consequently the alkaline, biliary, and pancreatic secretions may rise higher and more readily neutralize the acid chyme in the first portion of the duodenum in women than in men.

In an early state of fetal existence the duodenum above the common duct is a part of the pyloric end of the stomach. Coming from the primitive foregut, it is associated with the stomach in its physiology and pathology, and is not a part of the small intestine, which comes from the midgut. The embryonic stomach is rotated on its right side, and its original posterior wall becomes the greater curvature. The primitive anterior wall, which has become the lesser curvature, retains its normal shape, but a pouch is formed by an expansion or dilatation of the primitive posterior wall (greater curvature), and this becomes the fundus or storage end of the stomach. The pyloric end retains its intestine-like appearance, but develops a high muscular potentiality. The embryonic duodenum is rotated about the head of the pancreas and becomes more or less fixed by the loss of some of its posterior peritoneum in the lower portion. The duodenum is U-shaped, with its concavity directed toward the left and upward. Its outlet is within an inch and a half of its pyloric entrance. The large caliber, fixed position, and trap-like shape of the duodenum make it an admirable mixing receptacle, and siphonage plays almost as important a part as muscular action in emptying it.

In many animals the entrance to the pyloric end of the stomach is controlled by a true sphincter which does not exist in man, although physiologic contraction graphically marks its situation. The terminal three-fourths of an inch of the pyloric end of the stomach, the so-called "pyloric canal of Jönnesco," may be considered a part of the sphincter apparatus of the pylorus, serving as a passageway only. It is not subjected in the same manner to the traumatism and contact with acid gastric secretions which constitute so potent a factor in the production of ulcer in both the pyloric end of the stomach and the upper duodenum; therefore, primary ulcers in the pylorus and pyloric canal are rare.

Ninety per cent. of gastric ulcers are to be found in the pyloric end, which contains but one-sixth of the gastric mucosa, while the beginning of most duodenal ulcers will be detected at the point of impact where the acid chyme is forcibly ejected through the pylorus against the duodenal wall.

Physiologically the acid chyme in the pyloric end of the stomach stimulates the gastric motor and secretory functions. In the upper duodenum it controls the pyloric apparatus, and the rate of the gastric outflow is regulated by the rapidity with which this acidity is neutralized by the alkaline, biliary, and pancreatic secretions.

Pathologically the acid stomach juices, either because of perverted secretion or through lack of local resistance, or both, become the most important factor in the development of ulcers, and largely confines their ravages to these two embryologically associated structures, the duodenum and the pyloric end of the stomach.

The first notable contribution to the subject of duodenal ulcer and its surgical treatment was the presidential address before the American Surgical Association in 1900 by Dr. Robert F. Weir. The total number of cases reported at that time was small, and nearly all of them were acute perforations into the free peritoneal cavity.

Perforation is comparatively common, but fortunately the contents of the duodenum are relatively sterile and small in amount, which favors plastic protection. In the 272 operations (up to June 1, 1908), perforation was found 66 times: 16 acute, with three deaths; 13 subacute, with abscess, no deaths, and 37 chronic protected, with one death.

Acute perforation of the duodenum is sometimes diagnosed as perforative appendicitis, and, as remarked by Codman, it is probable that a number of acute perforations are not differentiated even at the operating table, and a careful examination of the appendix in some cases of septic peritonitis from supposed appendiceal perforation would show that its peritoneal surface only was involved and that the lesion was in the duodenum.

Out of 27 cases of acute perforation of the stomach and duodenum in which we have operated, 16 were duodenal. In 3 suture of the opening and gastrojejunostomy was done, in 13 suture without gastrojejunostomy, and of these only one required secondary gastrojejunostomy. In addition, 12 subacute perforations were walled off, with encapsulation of infected material which had escaped from the perforation and caused a secondary abscess to

form, such as described by Lund. All but one of the patients with acute and subacute perforations have remained well, the perforation having seemingly put an end to the disease. In this one exception, although the ulcer was healed, a secondary obstruction rendered gastrojejunostomy necessary at a later period.

Acting on this observation, we have four times produced the condition of perforation by cutting out the crater of the ulcer and closing the defect by suture. The results have been good, but sufficient time has not elapsed to know if it will be permanent; but it is a much easier and safer operation than the excision of the entire indurated and cicatricial area about the ulcer which we have heretofore practised. The extensive operation, however, would be indicated if there was any evidence of malignancy, which, as we have already pointed out, is less liable to take place in ulcer of the duodenum than in ulcer of the stomach.

Chronic protected perforation occurred 37 times. In the chronic form, unlike the acute form, incomplete perforations with adhesions protecting the base of the ulcer seemed to act as an aggravation to the condition, and recurring attacks of local peritonitis were the rule, often producing symptoms resembling those of gall-stone disease, for which the manifestations were sometimes mistaken.

A marked peculiarity of duodenal ulcer is the periodicity of the attack, beginning as a rule, in early adult life. The subject, usually a male, has an attack of stomach trouble, of which acidity is a prominent feature. This lasts a few days or weeks and is followed by an "almost well" period of weeks or months. These symptoms recur with increasing frequency, the patient finding some relief from a restricted diet. In the later stages mechanical obstruction often appears. Hemorrhage occurs in about one-half of the cases.

A differential diagnosis between gastric and duodenal ulcer can usually be made. In duodenal ulcer the pain and tenderness, as a rule, extend from the mid-line to the right; aggravation induced by food comes on several hours after a meal, and the patients suffer from a peculiar "hunger pain" when fasting.

Unlike gastric ulcer, duodenal ulcer rarely undergoes carcinoma-

tous degeneration. We have seen but four apparently primary carcinomas of the duodenum. In two of these the origin was uncertain, and in but one did it seem probable that the cancer had developed on ulcer. In five cases, however, we have known gastric cancer to develop on the edge of a duodenal ulcer which involved the stomach at the pyloric ring.

The surgical treatment of chronic duodenal ulcer will usually consist of gastrojejunostomy, preferably the "no-loop" method.

We have made 311 gastrojejunostomies for ulcer of the stomach

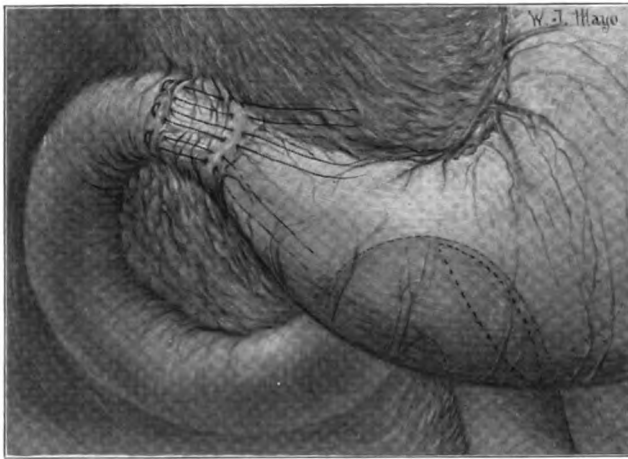


Fig. 68.—Ulcer of the duodenum with sutures in place for the purpose of enfoldment. Posterior no-loop gastro-enterostomy indicated.

and duodenum by this particular method, with a mortality of less than 1 per cent., and but three patients have required a secondary operation on the stomach or duodenum for any cause.

If the ulcer has caused hemorrhages, we tie the blood-vessels leading into it, and with sutures cover with sound tissue (Fig. 68). Should there appear to be any danger of perforation, the site of the ulcer is covered in the same manner as recommended by Mr. Moynihan, who calls attention to the possibility of secondary perforation.

In four cases we have excised the ulcer with direct union to the

stomach. This did not prove a very satisfactory procedure, as in two of them we were compelled to do gastrojejunostomy later. In several of the cases, however, we were able to excise the ulcer and close by plastic repair after the Finney plan with good results.

In one case an obstructing ulcer of the duodenum an inch and a half below the pylorus so angulated the duodenum on itself that it was comparatively easy to do duodeno-duodenostomy between the first and second portions of the duodenum. Fig. 69 is from a drawing of an hour-glass duodenum, the result of ulcer, which was cured by resection with end-to-end union.

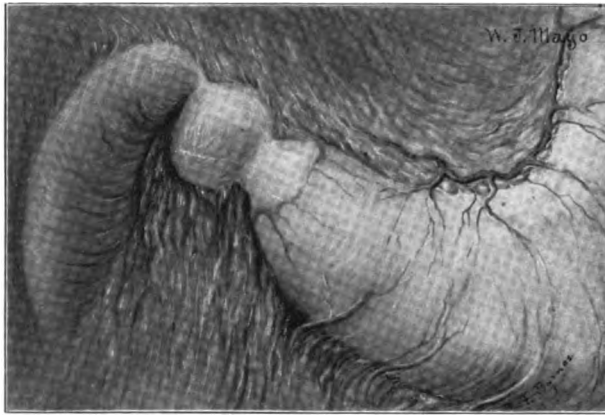


Fig. 69.—Hour-glass duodenum which was treated by excision with end-to-end union between the duodenum and the stomach.

In this connection I wish to call attention again to Fig. 67. The arrangement of the blood-vessels of the duodenum just below the pylorus is such that if the pyloric end of the stomach is pulled upward rather firmly, as one must often do to obtain a view of the parts, an anemic spot will appear in the duodenum just below the pyloric ring. This appearance is at times very striking and may closely resemble an ulcer. On one or two occasions we were obliged to incise the duodenum at this point before we could be certain that no ulcer existed. The tissues apparently involved are normal to the feel and do not have the milky appearance of the

peritoneum of true ulcer, and there are neither adhesions nor other abnormality. If the traction is taken off, it will be seen at once that no ulcer exists.

There has been much discussion as to the curative value of operation for ulcer. From our own experience we can say that the surgical treatment has been most satisfactory. The small esteem in which surgery of the stomach and duodenum is held by many professional men, and the bad results reported, have been largely due to mistakes in diagnosis and unnecessary operations performed where no ulcer existed.

We have, as far as possible, traced our patients with duodenal ulcers operated on in 1906-07. These two years were chosen because this choice eliminated some of the early operations in which the diagnosis was doubtful and the technic imperfect, and it prevented the inclusion of the recent cases that the shortness of time since operation would render valueless to statistics from the standpoint of cure.

Of the 119 patients operated on in 1906-07, we have information of 106. Of these 87, or 82 per cent., were cured; 10, or 9.5 per cent., improved; and 6, or 5.7 per cent., unimproved, making cured and improved 91.5 per cent. The operative mortality in the whole number of cases was 2.8 per cent.

ANEMIC SPOT ON THE DUODENUM WHICH MAY BE MISTAKEN FOR ULCER *

BY WILLIAM J. MAYO

It sometimes happens that it is difficult to secure a proper exposure of the first two inches of the duodenum in order that it may be inspected and palpated for the detection of ulcer. The usual method is to grasp the pyloric end of the stomach and pull it to the left as well as up into the abdominal incision in such a manner as to draw the first portion of the duodenum into view.

The arrangement of the blood-vessels immediately distal to the pylorus is such that this traction may interfere with the vascularization, and the local anemia thus produced cause a white spot to appear on the duodenum just below the pylorus.

In some cases this appearance is very striking and may be mistaken for ulcer. In two cases in our early experience we were compelled to incise the duodenum at this point before we could convince ourselves that an ulcer was not actually present.

After one has had his attention called to this condition, the differentiation is not at all difficult. It will be noted that the peritoneum covering the supposed ulcer has not the characteristic milky color of true ulcer; there are no adhesions, and palpation does not reveal either thickening or cicatrix, and, of course, upon removing the traction the anemic spot disappears. (See Fig. 70.)

* Reprinted from "Surgery, Gynecology and Obstetrics," June, 1908, pages 600-601.



Fig. 70.—Anemic spot resembling an ulcer on the duodenum. Showing effect of traction on the pyloric end of the stomach for the purpose of exposing the pylorus and upper duodenum, which may cause an *anemic spot resembling an ulcer to appear on the upper duodenum*.

PANCREATITIS RESULTING FROM GALL-STONE DISEASE *

By WILLIAM J. MAYO

In December, 1907, we (W. J. and C. H. Mayo) made a collective investigation of our operative experience in the surgery of the upper abdomen. Among other statistics compiled it was found that in 2200 operations on the gall-bladder and biliary passages the pancreas was coincidentally affected 141 times (6.1 per cent.). As the total of all pancreatic diseases operated on was only 168, the interesting fact was brought out that 81 per cent. were due to or accompanied by gall-stones.

In 268 operations on the common and hepatic ducts the pancreas showed disease in 18.6 per cent., against 4.45 per cent. where the gall-bladder only was involved. In 124 cases the head of the pancreas showed evidence of inflammation, while in only 17 cases was the entire organ affected.

The pancreas is the great abdominal salivary gland, and it lies in a most protected situation. No other organ in the body, with a function so valuable, is so little liable to intrinsic disease. Its natural defenses have but one single defect, and that is the mechanical association of the main pancreatic duct with the common duct of the liver.

The stomach and duodenum, above the common duct, and the liver and pancreas have the same embryologic origin from the primitive foregut. These organs are associated in their physiology and pathology and are concerned in the preparation of food for digestion. The force which correlates their function is chemical

* Reprinted from "The Journal of the American Medical Association," April 11, 1908, vol. i, pp. 1161-1164.

through the harmonious action of their secretions rather than nerve impulses (Starling).

The control of the pylorus and its output depends on the rapidity with which the acid chyme is neutralized in the upper duodenum by the pancreatic and biliary secretions (Pawlow). The presence of chyme in the upper duodenum stimulates those duodenal secretions on which the secretory functions of the pancreas depend, while the bile activates the pancreatic juices and adds greatly to their digestive effect.

The derivatives of the midgut consist of the intestines which lie between the common duct and the splenic flexure of the colon and are concerned in absorption. The solids are very largely taken up in the small intestine; the fluids, which are chiefly from the pancreas and liver, mechanically float the solid matter to the ileocecal valve, and bring every part of the mucous membrane in contact with the intestinal contents. This fluid, now of no further mechanical use, is reabsorbed in the head of the colon. The storage function of the intestine begins at the splenic flexure, continues to the rectum, and is derived from the primitive hindgut. The influence of chemical stimulation (hormones) is the potent one between the beginning of the pyloric end of the stomach and the sigmoid.

In embryology, function is more permanent than form. The small intestine, morphologically, begins at the pylorus, but functionally it begins at the common duct. The large intestine begins at the ileocecal valve, but as a reservoir it begins at the splenic flexure of the colon. The muscle which was at one time to be found at the beginning of the antrum of the stomach has disappeared, but physiologic contraction still begins at this point. The cecocolic sphincter is also gone, but muscular contraction here still holds the fluids in the cecum during absorption.

In this whole process the pancreatic secretions are the most important, and in the diagnosis of pancreatic lesions a study of the intestinal functions, as evidenced in the feces, is the most important means of differentiation.

The pancreas begins as diverticula from that part of the lower end of the primitive foregut which is to become the upper duo-

denum. During the fourth week of fetal life these buds project into the posterior mesogastrium and form the two primary lobes of the pancreas, each with its own duct. The two lobes eventually coalesce, and the lower, or duct of Wirsung, becomes the main excretory channel. The duct of Santorini opens anterior and above

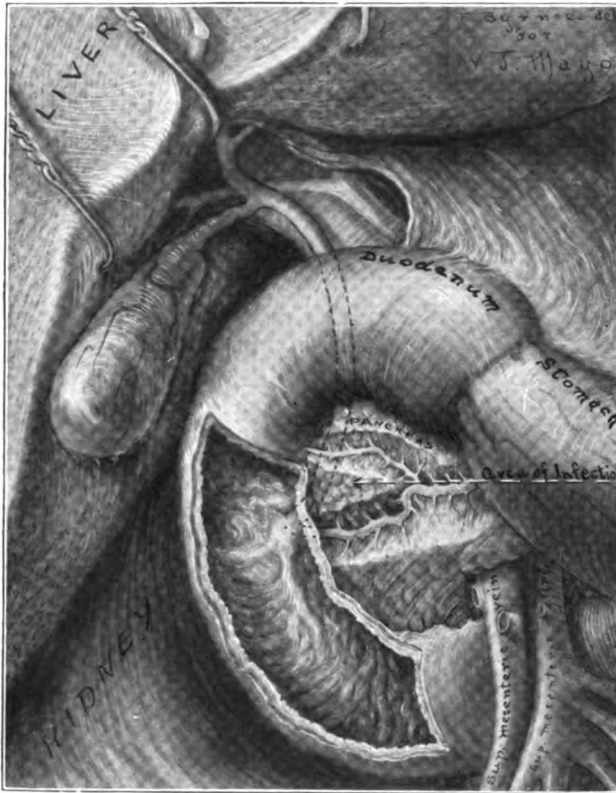


Fig 71.—Showing the normal relation of the biliary and pancreatic ducts to the pancreas and duodenum.

the duct of Wirsung, and in nearly half the cases is able to maintain pancreatic excretion (Fig. 72). The ducts of the pancreas have no valves, but the ampulla of Vater is provided, and into that little cavity, in conjunction with the common bile-duct, the duct of Wirsung normally opens. This latter feature is found only in the carnivora and in the omnivora.

In 62 per cent. of human subjects the terminal third of the common duct is embedded in pancreatic tissue, while in 38 per cent. it lies behind the pancreas in the groove between it and the duodenum (Helly). Therefore, sixty-two times out of a hundred any structural change in this portion of the pancreas will interfere with the liver excretion through the common duct, giving rise to jaundice, while a stone in the terminal portion of the common duct, or infection caused by stone in any portion of the bile tract, exposes the duct of Wirsung, and through it the pancreas, to infection. If a stone in the common duct compresses the duct of Wirsung, the safety of the patient may depend on the possible presence of a patent duct of Santorini, or if the stone lies in the papilla, the bile may force its way up into the duct of Wirsung and set up a chemical pancreatitis.

In this unfortunate association of terminal facilities the large percentage of known diseases of the pancreas have their etiology (Opie).

The "triangle of pancreatic inflammation" is that part of the head of the pancreas which lies between the duodenum on the right and the ducts of Santorini above and Wirsung below. Mr. Snyder Philips has shown (Fig. 71) that catarrhal jaundice, especially the epidemic form, is probably due to pancreatic disturbance and is similar to such inflammations of the parotid gland as mumps.

Acute and Subacute Pancreatitis.—Our knowledge of acute pancreatitis is largely due to that eminent American physician, Reginald Fitz, to whom we also owe the pathology of the appendix and of Meckel's diverticulum. If the inflammation is acute, hemorrhagic pancreatitis may result and possibly the whole pancreas be destroyed in a few hours. If the process is less acute, suppuration may take place or local disease of the blood-vessels will permit bleeding into the pancreas—the so-called "pancreatic apoplexy." We have met with the late results of this latter condition in two cases.

The most interesting feature of acute pancreatitis concerns fat necrosis, a disseminated necrosis of fat due to the escape of pancreatic ferments which involve, to a greater or less extent, the omen-

tum, mesentery, retroperitoneal and other adipose tissues. In two of our cases there was partial suppression of urine, accompanied by delirium and a semi-comatose condition lasting several days. It was found on operation later that the kidney outline on each side

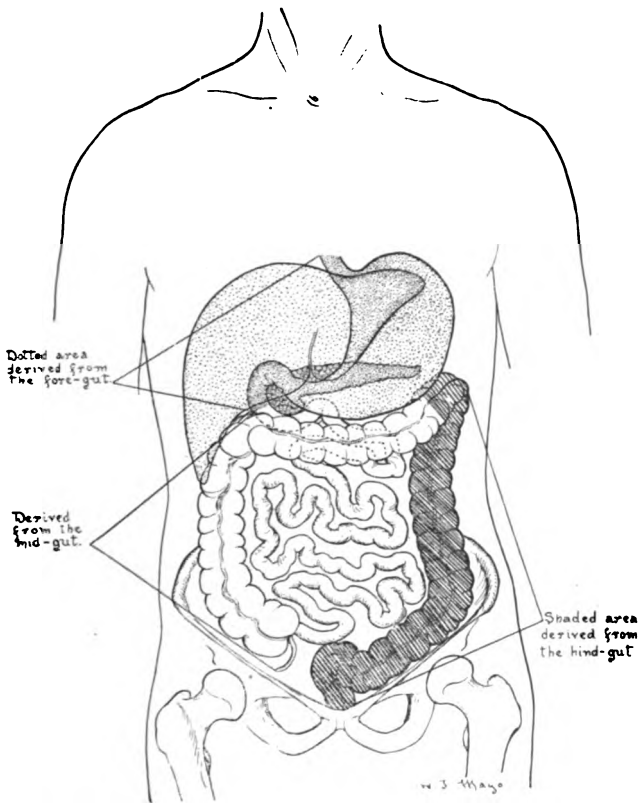


Fig. 72.—Showing the embryonic origin of the gastro-intestinal tract.

was lost, evidently by the effect on the perirenal envelopes of the fat-splitting ferments.

The pancreas in the fetus is an intraperitoneal organ. At birth its posterior peritoneum has become converted into connective tissue, but the area of distribution, both within and without the peritoneal cavity, of pancreatic leakage suggests the influence of

the fetal condition. Fat necrosis is probably the result not of normal pancreatic secretions, but rather of pancreatic juice which has become activated by associated ferments either from the bile or from the duodenal mucous membrane.

In 172 resections of the stomach we have lacerated the surface of the pancreas many times, and in eight instances have removed portions of the gland, but in no case did fat necrosis follow.

There is undoubtedly an exaggerated idea as to the fatality of fat necrosis. The majority of our patients were operated on not in the acute stage, but in the subacute stage, after the patients had become more or less convalescent. Our knowledge heretofore has come largely from the dead-house, and as only fatal cases were discovered, the disease has appeared to be a very fatal one.

Acute pancreatitis has a sudden onset and is ushered in by agonizing pain in the upper abdomen, with collapse, followed by extreme prostration. The pulse becomes quick, there is some elevation of temperature, with nausea, vomiting, and rapid abdominal distention. The acuteness of the symptoms suggests obstruction, which is belied by the ability to secure the passage of flatus. The patients are usually elderly, obese, and often have alcoholic histories.

On opening the abdomen the pancreas is found greatly enlarged, softened, and indefinite in outline, with more or less free peritoneal fluid and pea-like areas of fat necrosis. If gall-stones exist, they should be removed quickly and the gall-bladder drained. In all cases where free fluid is found in the peritoneal cavity temporary abdominal drainage should be established (Woolsey). Of three acute cases of pancreatitis, two patients recovered, one died. In nine subacute cases all the patients recovered.

Chronic Pancreatitis.—The greatest interest in connection with gall-stone disease concerns the chronic forms of interstitial pancreatitis, of which Riedel reported six cases as early as 1896. Our knowledge of the chronic variety is, however, largely due to the work of Robson, who reported the first operative case in 1900. Robson states that 60 per cent. of his operations for the removal of common duct stones showed an associated chronic inflammation of the pancreas.

Mild infection and interference with drainage appear to be the main etiologic factors, and the "triangle of infection" is usually involved early, thus compressing the common duct in the 62 per cent. of cases in which its terminal third is embedded in the head of the pancreas. There are two forms of interstitial pancreatitis—the interlobular and the interacinar. The interlobular is fortunately the one most often associated with gall-stone disease. In this type the pancreas is enlarged, nodular, rough, and to the "feel" greatly resembles cancer. In the interacinar form the pancreas feels smooth and tough and is extremely liable to be associated with glucosuria. The reason for this lies in those peculiar bodies of ductless gland tissue which are to be found throughout the pancreas, and are named, after their discoverer, the islands of Langerhans. These little cell masses, which derive their blood-supply from the vessels of the pancreas, but have no connection with the pancreatic ducts, in some way appear to control carbohydrate metabolism, and when destroyed or compressed, as occurs in the interacinar form, diabetes may result. They can be compared to the relation of the parathyroids to the thyroid gland.

The interlobular form, however, may also gradually progress until the gland substance is involved with development of secondary diabetes. Robson found sugar in the urine in 6 per cent. of his common duct cases, which disappeared after operation.

Clinical Course and Symptoms.—Chronic interstitial pancreatitis may extend over years of time without producing such symptoms as would readily differentiate the complication from the original disease, but if its possibility is borne in mind and careful search made, evidence can be elicited to show the nature of the condition, and if pancreatic changes are present, it indicates an early resort to surgical interference.

Jaundice is one of the most marked symptoms and may last for months or years. The emaciation is more extreme and the pigmentation of the skin is more marked than in simple uncomplicated common duct stones (Robson). As the antecedent disease is most often gall-stones, an early history of this condition can usually be obtained. If the stones are in the common duct, Cour-

voisier's law holds good, and in 86 per cent. of the cases the gall-bladder will be found contracted. A distended gall-bladder may occur if the biliary passages are normal, but such distention, with jaundice, usually indicates cancer rather than chronic pancreatitis.

In a thin patient the enlarged pancreas can sometimes be felt as a hard mass lying transversely across the upper abdomen. Careful examination of the stools gives much important evidence. They are pasty, very large on account of undigested food, and contain quantities of fat. Even if there is no jaundice, the bile, which without pancreatic juice gives only a light yellow color to the stool, is not sufficient to stain the great quantities of fat which are passed off, so that frequent large, light-colored, greasy motions, without jaundice, are indicative of pancreatitis. Estimation as to the quantity of stercobilin should be made. Undigested muscle-fiber can often be detected in the stool.

Mr. Cammidge has pointed out that certain crystals are to be discovered in the urine in pancreatic inflammations, and that if detected they are pathognomonic. The Cammidge test is a slow and laborious one and has been more successful in the hands of its originator than with others. Our experience with it, while not extensive, seems to bear out much of his claims for it.

We have not found that the presence of chronic interstitial pancreatitis has greatly influenced the prognosis after gall-stone operations, although there is undoubtedly a much greater tendency to hemorrhage than without the pancreatic complications. For this reason we have used either the chlorid or lactate of calcium to assist coagulation of the blood before and after operation. We are, however, in doubt as to its actual value.

The necessity of clearing out all of the calculi, especially from the common duct, cannot be emphasized too strongly. Stones are especially liable to be lodged under the overhanging head of the enlarged pancreas, so that they may easily be overlooked, as we have found by experience. As a matter of fact, neither probe nor scoop can be depended on to "feel" a gall-stone in this situation, and we have never rested satisfied until we have freely opened the common duct and, if possible, inserted a finger into its lumen,

making sure that no gall-stone has escaped detection. In the same manner, in the majority of cases, the hepatic duct and the entrance to its right and left primary divisions can be searched for calculi having their origin in the gall-bladder, but which have been crowded back into the hepatic ducts.

After clearing the ducts of stones a large malleable probe should be passed through the common duct into the duodenum so as to secure thorough dilatation to permit the escape of any hepatic duct stones which may come down later. Hepatic duct stones, as a rule, are not large, and if free drainage into the duodenum exists, even for a few days, they may find their way out; otherwise they might be retained in the common duct, necessitating secondary operation, as occurred in five of our cases.

Eloesser has recommended that the third portion of the common duct be stretched to loosen up the pancreatic adhesions. Robson points out that free drainage for the bile is essential, and in most cases this alone seems to be sufficient for cure. Cholecystostomy or cholecystenterostomy are the indicated procedures. The latter operation has the advantage of equally free drainage and at the same time maintaining the influence of the bile in intestinal digestion. In our experience, when the common duct contained stones, the removal of them, with temporary external drainage, has resulted in the symptomatic cure of the pancreatitis. If there are no stones in the common duct or gall-bladder, other things being equal, we have preferred cholecystduodenostomy, and out of twenty-four cholecystenterostomies nine were performed for this cause.

It will be noted that where Robson found pancreatitis in 60 per cent. of his cases of stone in the common duct, we have found it in only 18.6 per cent. This difference depends somewhat on the personal equation of the surgeon, as on the operating table the diagnosis is made from the "feel" and character of the enlarged gland. We have classified, as chronic pancreatitis, only those cases in which the pancreas was so definitely enlarged there could be no possible doubt that the disease actually existed. Undoubtedly by a more careful examination of the urine and stool Mr. Robson and Mr. Cammidge have been able to make the diagnosis in cases we have heretofore overlooked.

THE SURGICAL TREATMENT OF PANCREATITIS*

By WILLIAM J. MAYO

Introduction.—Digestion, absorption, and assimilation are primary functions of the body, and were accomplished facts before there was a nervous system, and the necessary control was obtained from certain organic internal secretions.

The sympathetic nervous system, probably mesoblastic in origin, came next as an aid to internal secretions and is still found closely connected with the organs which produce internal secretions. The thyroid is closely associated with the cervical sympathetic, the adrenals were for a long time supposed to be sympathetic ganglia, and the pituitary body is half sympathetic ganglia and half gland.

The development of the cerebrospinal nervous system was a later evolution which has become predominant. Nature has, however, not allowed the central nervous system to wholly usurp these original methods of control, hence internal secretions still act as "chemical messengers," and to a large extent they control digestion and assimilation. The struggle for supremacy of the advancing central nervous system over the internal secretions and the sympathetic ganglia gives rise to irregular function and may lie back of much of the prevalent neurasthenia, digestive neurosis, visceral ptosis, etc.

The surgeon cannot intelligently operate upon organs of double function without a full knowledge of their internal as well as their external secretions, for herein may lie the cause of the failure of a mechanically well-executed operation to cure the patient.

The pancreas is an organ of internal and external secretion. Its

* Read before the Mississippi Valley Medical Association, Louisville, Kentucky, October 14, 1908. (Reprinted from "Surgery, Gynecology, and Obstetrics," Dec., 1908, pages 607-613.)

internal secretion is actively associated with those of the intestinal glands, especially Brunner's glands in the duodenum, and also with the thyroid and adrenals. This activity is probably expressed through the islands of Langerhans, which seem to have a large influence on carbohydrate metabolism.

The external secretion of pancreatic juice is even more closely associated with that of bile from the liver, and so important is this latter association that by a process of evolution the pancreatic and common bile-ducts have become joined just before entering the duodenum, and a small cavity, the ampulla of Vater, results, which acts as a mixing chamber.

A study of the comparative embryology of the derivatives of the primitive foregut, from which the stomach and duodenum to the common duct and the pancreas and liver are formed, throws an interesting sidelight on this anatomic relationship. The fetal pancreas has two lobes, each with a duct having a separate opening into the duodenum. In the adult, the upper or duct of Santorini, although it has an orifice uncomplicated with the common bile-duct, has become more or less obsolete, while the duct of Wirsung is the main excretory channel. This suppression of the direct flow of pancreatic juice through the duct of Santorini in favor of the indirect duct of Wirsung, shows the importance of the association of the liver secretion to digestive function. The variability of the useful possibilities of the duct of Santorini indicates that this change is a recent evolution.

The liability of the appendix to disease, of the wisdom teeth to early decay, and of the little toes to corns and callosities, are examples of defects from progressive loss of function. Advancing function makes anatomic imperfections, shown in the variability in the length, shape, and size of the sigmoid (Finney). As this derivative of the primitive hindgut increases its capacity as a fecal storehouse, it may result in constipation and irregular bowel action. It would appear that the changing digestive function is acting in the same way. The duct association of the pancreas and liver with its pathologic tendencies shows the instability of short heredity. The gall-bladder changing from a bile storehouse to an organ

needed for the relief of tension in the common duct and for the production of mucus, exhibits, in gall-stone formation, the same tendency to disease.

The lack of harmony in the results of experimental work on the internal secretions of the pancreas shows that this function is on the wane, just as happened in an opposite way in the thyroid, now an organ of internal secretion only, but at one time possessing an external secretion which escaped by way of the thyro-glossal duct at the foramen cæcum at the base of the tongue.

The testicle is another example of internal and external secretion. The interstitial cells of Leydig, which largely atrophy at puberty, through internal secretion continue the growth of the external evidences of manhood in those cases of sterility in which the testicles are incapable of producing semen. The association of normal function is here much the same as in the subject under consideration. The prostate adds its less important but necessary secretion to the testicular, much as bile is added to the pancreatic juice. Possibly the prevalence of prostatic disease may in its primary origin be the result of evolutionary changes.

The importance of the pancreas is shown by its protected situation. It has the fatal defect, already pointed out, of union of terminal facilities with the common bile-duct, to which unfortunate mechanical arrangement most of the diseases of the pancreas are due, because it is thereby exposed to infections and diseases originating in the liver, gall-bladder, and ducts. We are also beginning to understand that the liver is equally unfortunate, as it is in the same manner exposed to diseases originating in the pancreas.

Our knowledge of pancreatitis may be said to be the result of an inquiry into the causation of some of the complications of gall-stone disease.

This lengthy preamble is rather by way of explanation of our lack of definite surgical knowledge, and to indicate that the following is but an imperfect clinical attempt to present the present status of a growing subject which must in a short time be subjected to more exact methods of study. (Fig. 73.)



Fig. 73.—Showing the relation of the biliary and pancreatic ducts to the head of the pancreas and duodenum.

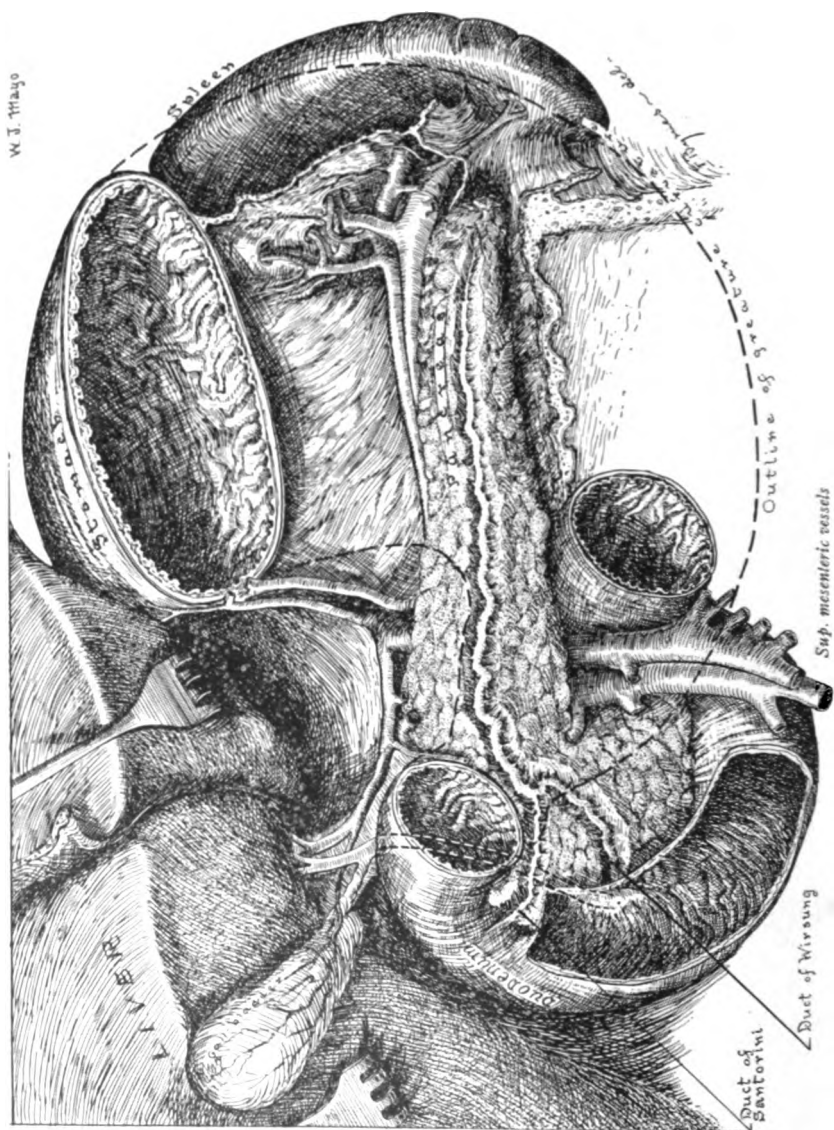


Fig. 74.—Showing relation of pancreas to stomach, duodenum, and liver.

Acute Pancreatitis.—The surgical treatment of acute fulminating pancreatitis presents difficulties which in many cases are insurmountable. The patient, often a fleshy alcoholic male, exhibits all the symptoms of an acute perforation of some viscus, and when first seen is in a state of more or less collapse and a bad subject for an operation of any kind. The large majority of patients die whether operated on or not, yet immediate operation offers the best prospect of cure, and while the mortality is exceedingly high, it is not prohibitive. Of 59 cases reported by Robson, 23 recovered.

If the patient is seen during the first forty-eight hours, the abdomen should be opened in the median line above the umbilicus. More or less bloody serum will be encountered, and often disseminated nodules of fat necrosis in the tissues even at this early time. The greatly swollen pancreas, having a semifluctuating "feel," showing gross hemorrhagic infiltration, will easily be detected and should be incised in several situations, as was done in the successful cases of Mikulicz, Robson, and others. If the hemorrhage from the incisions in the pancreas is severe, it may be necessary to pack with gauze and hold firmly in place with catgut sutures. Free drainage should be furnished, and, as a rule, through the anterior abdominal incision rather than through the posterior. The drains should be brought to the surface through split-rubber or glass tubes. As pointed out by Woolsey, the mere opening of the peritoneal cavity, with drainage if fluids are present, seems to have a beneficial effect in some cases, evidently stimulating the natural resistance.

If there are stones in the gall-bladder or ducts, or an acute infection of the biliary passages, removal of the stones and bile drainage through a right lateral incision should be done, provided the patient's condition will permit. If any degree of jaundice is present, bile drainage is essential.

After forty-eight hours the problem becomes more complex and depends largely upon the amount and virulence of the ensuing infection. As a rule, anterior drainage will be found more practical than posterior, because the head of the pancreas, which is most often involved, lies in front of the spinal column and does not offer,

anatomically, a good opportunity for the posterior route, although it must be admitted that some danger of infection is avoided if the phlegmon can be drained from behind by an incision outside of the erector spinæ muscles. However, free drainage anterior is capable of better management, and should more or less of the pancreas slough, which has happened in a number of reported cases, including one of our own, the after-treatment can be more carefully carried out from in front, and the necrosed portion of the gland more readily removed than from behind.

Subacute Pancreatitis.—The surgical treatment of subacute pancreatitis presents a more favorable field for operation. The patient has lived through the serious stage of acute infection, and his resistance has been greatly increased. Our early knowledge of acute pancreatitis was based largely upon dead-house observations and we had an exaggerated idea of its fatality. For instance, fat necrosis, the result of the leakage of pancreatic ferments is by no means so deadly a condition as has been supposed. We have operated upon a number of cases in which this result of acute pancreatitis was found. The patient had gone through a most serious illness and was apparently on the road to recovery, or at least was in the convalescent stage. On opening the abdomen, scattered all through the omentum, mesentery, and other fatty tissues, will be found these little split-pea-like areas of fat necrosis. The peculiar disposition of these manifestations of the escape of fat-splitting ferments both behind and inside of the peritoneal cavity is explained by the fact that in the fetal state the pancreas is an intraperitoneal organ which by evolution has become extra-peritoneal.

In subacute pancreatitis the pancreas may show evidence of localized septic accumulations; these pockets should be opened and drained. If calculi are present in the gall-bladder or bile-ducts, they should be removed and free drainage instituted. Especially should we be sure that no gall-stones remain hidden in the common duct under the enlarged head of the pancreas.

Three times we have found localized non-infected accumulations of blood in the pancreas or adjacent tissue, the result of pan-

creatic apoplexia. All of these cases recovered after simple drainage. (Fig. 74.)

Chronic Pancreatitis.—Chronic pancreatitis was first described by Riedel in 1896, but the first case intelligently operated upon was one by Robson in 1900, and to him we owe the modern conception of this disease. The fundamental principle of the surgical treatment consists in temporary or permanent disassociation of the pancreatic and liver ducts by relieving the common duct of as much of its bile-carrying function as possible. In about two-thirds of cases the common duct passes through the head of the pancreas to reach the duodenum, and one-third pass behind it. It will be readily seen that in two-thirds of the cases of pancreatitis drainage through the common duct will be seriously interfered with and jaundice may be expected. In one-third of the cases jaundice will not necessarily be present, but even here the common duct will usually be found more or less dilated. Dilatation of the common duct may occur quite independent of gall-stone disease, and both the ducts and the gall-bladder may be considerably distended without noticeable jaundice.

As pointed out by Courvoisier, 84 per cent. of cases of stone in the common duct have a contracted gall-bladder due to the large amounts of connective tissue in its walls, the result of gall-stone irritation. Therefore, the size of the gall-bladder in chronic pancreatitis depends largely upon whether gall-stones are or have been present.

It is the rule that primary jaundice with the presence of a distended gall-bladder indicates malignant disease, but an exception must be made of the not infrequent cases of pancreatitis which do not have their origin in gall-stones, and, therefore, may have a distended gall-bladder. In malignant disease the glands in the fissure of the liver are usually involved, early causing pressure upon the portal vein, one result of which may be the presence of free fluid in the abdomen, which is not a frequent result of chronic pancreatitis.

It will readily be seen that when the pancreas, as the result of infection, becomes swollen and causes pressure upon the common

duct, it seriously interferes with biliary drainage, and, though the pancreas may have become involved secondarily, it prevents that free drainage of the liver secretions which is so essential to the relief of the infection upon which the pancreatitis depends. The surgical treatment of chronic pancreatitis is not usually directed to the pancreas itself unless pancreatic calculi or other foreign bodies be present, but rather to the biliary tract, and is best accomplished by diverting the bile to the surface by means of a cholecystostomy, or to a new point in the gastro-intestinal canal by cholecystenterostomy.

In the large majority of cases gall-stones in the gall-bladder or biliary tract are the direct cause of the chronic pancreatitis. Up to September, 1908, in 2611 operations upon the gall-bladder and bile tract (C. H. and W. J. Mayo) the pancreas was coincidentally involved 200 times, or 7.6 per cent. In 325 operations on the common and hepatic ducts, the pancreas was involved in 22 per cent.

When gall-stones are present, the removal of these stones, with temporary free drainage by means of a cholecystostomy, can usually be depended upon to cure chronic pancreatitis. The infection caused by the stones is readily relieved by this drainage, and in a comparatively short time the pancreatic pressure upon the common duct disappears and a permanent cure ensues.

In those cases of chronic pancreatitis in which no stones are present, cholecystostomy cannot be relied upon, because the continuation of the pancreatic disease lies outside of and beyond the biliary tract, and in these cases more prolonged, if not permanent, diversion of the bile from its pancreatic association is necessary, and cholecystenterostomy is indicated.

In several of our cases in which unsuspected chronic pancreatitis existed in connection with gall-stone disease, and in which cholecystectomy had been made, serious difficulties followed, and were relieved only by secondary drainage of the common duct, all of which would have been avoided if in the original operation the gall-bladder had not been removed. For this reason, unless there is malignant disease in the gall-bladder, or this organ had lost its function through permanent obstruction of the cystic duct, we do

not remove it if we have reason to believe that the pancreas is involved. A previous history of cholangitis, frequent attacks of jaundice, or stones in the common duct, contraindicate cholecystectomy, and the preservation of the gall-bladder enables a secondary cholecystenterostomy if necessary.

In a number of instances in which we had an opportunity to examine the common duct some time after cholecystectomy, we found that it was usually dilated, and in five of these cases stones had formed in the common and hepatic ducts subsequent to the removal of the gall-bladder.

From the observations referred to above, it would seem that the gall-bladder has some considerable function. The amount of mucus which escapes from gall-bladder fistula when there is obstruction of the cystic duct goes to show that production of mucus is part of its function. Flexner showed that bile which contained considerable quantities of mucus was much less liable to cause pancreatitis than pure bile.

The fact that after the removal of the gall-bladder the common duct is so frequently found dilated must be taken into consideration, and it seems probable that the gall-bladder has at least two functions: first, to produce mucus, and second, to relieve common duct tension in the head of the pancreas. Both of these functions are evidently of great importance in preventing pancreatic complications.

The long accepted opinion that the function of the gall-bladder was wholly to store bile seems improbable when we consider that from 20 to 30 ounces of bile are secreted each day, and the normal gall-bladder has a capacity of less than an ounce.

I am impressed with the fact that chronic pancreatitis is not only a much more frequent malady than has been supposed, but a more important one. In looking back over considerable experience in surgery of the gall-bladder and bile tract I find that a number of our cases that failed to make a good recovery failed because of pancreatic complications. It is certain that a much larger proportion of cases, especially those with a distended gall-bladder and a dilated common duct, with or without stones, should be treated by a

cholecystenterostomy than has been the practice among American surgeons.

Cholecystenterostomy was first performed by Winiwarter in 1880, but much of the early experimental work in connection with this subject was made by two justly celebrated Americans, the late Claudius H. Mastin, of Mobile, and the late W. E. B. Davis, of Birmingham, Alabama.

In the performance of this operation, union has been made between the gall-bladder and four distinct parts of the gastro-intestinal tract—the stomach, the duodenum, the jejunum, and the hepatic flexure of the colon. It must be conceded at the outset that union between the gall-bladder and the duodenum as near the orifice of the common duct as possible is the proper method, and should be practised where possible. Unfortunately, in a considerable percentage of cases the duodenum will be found deeply placed and firmly held by adhesions, so that union between it and the gall-bladder is a matter of great difficulty. Mobilization of the upper duodenum, as advocated by Kocher, is sometimes of value. It consists of a longitudinal incision through the peritoneum an inch or more in length just to the right of the duodenum in front of the kidney. Through this opening the duodenum is loosened from its posterior attachments and brought forward. By use of the curved clamps, union between the gall-bladder and duodenum can often be brought about, even when the parts are deeply situated, but in a fair number an anastomosis cannot be obtained without undue traction and some other part of the gastro-intestinal canal must be chosen.

We quite agree with Mr. Robson and Mr. Moynihan that if union cannot be safely effected with the duodenum, a loop of upper jejunum should be selected. For this purpose the transverse colon is pulled upward and to the right until the jejunum can be seen at its origin just at the left of the vertebral column. A loop from two to three feet in length is formed that can be easily brought up over the transverse colon to the gall-bladder.

Mikulicz, in doing this operation, advised that an entero-anastomosis should be performed between the two limbs of the attached

jejunum, and Monprofit has advocated a still more complicated method in which the jejunum is cut off, the proximal end being anastomosed to the gall-bladder and the distal end united to the side of the jejunal loop eight inches below, much after the manner of the Roux gastro-enterostomy. Nothing in our experience has yet arisen to make these complicated procedures necessary or desirable where the gall-bladder has been joined to a jejunal loop. It would seem wise to do entero-anastomosis as a secondary rather than as a primary operation in those cases in which subsequent trouble did appear.

Union between the gall-bladder and the stomach has been advocated and practised by Kehr in some cases. It is certainly an easy operation, and, if it can be shown that the free drainage of bile into the stomach is not harmful, it would have many advantages from a technical standpoint. The stomach is thick-walled, has a large blood-supply, and a certainty of union would be assured. In four cases we have found a spontaneous opening between the gall-bladder and stomach as the result of gall-stone sloughing. In these cases operation proved that nearly if not quite all of the bile was being discharged into the stomach, apparently without trouble.

Union between the gall-bladder and the colon, theoretically at least, is very unfavorable. The function of the bile in the small intestines is lost, and its stimulating effect upon the pancreatic juices is of very great importance. The fluids, however, and undoubtedly some of the solids, are saved to the economy through anastomosis with the colon, so that the patient is less thirsty and probably has stools more nearly normal than in those cases where the bile is carried permanently to the surface of the body by a cholecystostomy. In the few cases in which we made union between the gall-bladder and the colon no difficulty has arisen. Two of these patients have maintained excellent health for a number of years, and in neither did infection of the biliary tract result—a very serious danger, however, threatens the patient whose gall-bladder has been united to the colon, teeming as it is with virulent organisms. It is probable that the continuous flow of bile furnishes mechanical

protection. Fortunately circumstances demanding union between the gall-bladder and the colon will rarely occur.

As to the methods of accomplishing the anastomosis, but three are worthy of consideration: The suture which we have practised to the exclusion of all others for some years, is the ordinary two-row method exactly as in gastro-enterostomy, making the opening from 1 to $1\frac{1}{4}$ inches in length. We prefer to use catgut for the inner row and linen for the outer row. If linen or silk is used for the inner row, it may hang for months before it sloughs its way into the intestinal tract.

In all of our early operations we used the Murphy button without any failures or misfortunes due to the button itself. If the button is used, it should be protected by four separated mattress sutures of linen uniting the sero-muscular coats of the intestine and gall-bladder. A continuous suture of silk or linen should not be applied outside of the button, as that may prevent it from loosening and dropping into the intestinal canal.

The McGraw ligature has also been used with good results, the method of its application being quite similar to its use in gastro-enterostomy.

What shall we do in those cases in which the gall-bladder has been removed or is too contracted for the purpose of cholecystenterostomy? Drainage of the common bile-duct will probably be necessary, but Moynihan and Robson report cases cured by breaking up adhesions about the biliary ducts and pancreas, while Eloesser has stretched the common duct, breaking up adhesions about it in the head of the pancreas, with cure. The curious effect of the peritoneal incision in bringing about a cure in some cases is difficult to explain, but that it has at times a certain usefulness cannot be denied.

In conclusion I would draw your attention to some rather rare conditions due to congenital anomalies of the pancreas in which small accessory lobes are found entirely separated from the pancreas itself, and provided with ducts opening into the viscus to which it is attached. These accessory pancreatic lobules are not infrequently found in connection with the stomach or duodenum,

and occasionally with the jejunum or ileum. When they occupy these anomalous situations, they are even more liable to inflammatory disease than the pancreas itself, and may cause strictures or diverticulum which give rise to marked symptoms. At some future time I hope to report a small number of such cases that have come under our personal observation.

CYST OF THE ROUND LIGAMENT OF THE LIVER *

By M. S. HENDERSON

After a somewhat superficial search through the literature for data on the subject, the following report of a case is thought worthy of recording on account of its apparent rarity. Comparatively speaking, numerous references have been found of cysts of the round ligaments of the uterus, but none of cysts of the round ligaments of the liver. This case is the only one of the kind that has been met with in the Mayo Clinic at St. Mary's Hospital.

E. A. M., male, aged forty-one, presented himself for examination January 13, 1909. His complaint was the presence of an abdominal tumor. The following history was given.

One morning, about eight years before, on attempting to straighten up after stooping to lace his shoes, he was seized with a violent cramp in the region of the umbilicus. He was unable to stand erect on account of the excruciating pain, and had considerable difficulty in getting to his bed. The pain gradually lessened, and after a good bowel movement, the result of an enema, he was free from discomfort. There was no nausea and no vomiting during the attack. This attack was the only one of the kind that he had; but his business affairs were exacting and his general health began to fail. Symptoms at this time were indefinite; he was treated for neurasthenia, and soon after, while being examined by his physician, an abdominal tumor about the size of a lemon was discovered, the exact nature of which was doubtful. Laparotomy was advised, but deferred. Under treatment for his nervous condition he improved, was able to resume his business, and as the tumor gave him no discomfort, the operation was put off from year to year. The tumor gradually increased in size, however, until at the time of our examination it was about the size of a head.

* Reprinted from "Annals of Surgery," Sept., 1909.

Physical examination showed a rather thin, dark-complexioned man. Heart and lungs negative, as were also the blood and urinary findings. On palpation of the abdomen a freely movable fluctuating tumor was to be felt. When left to assume the natural position, it was seen to be just to the right of the umbilicus and a little below it. It was not tender, there was no tympany over it, and it did not move with respiration. The movement downward was more limited than the upward and lateral movements, as it could be easily placed in either flank or be pushed up beneath the

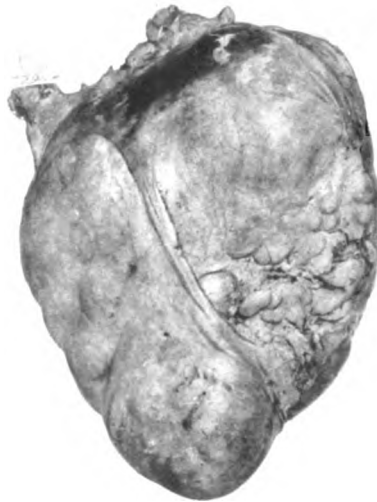


Fig. 73.—Cyst of the round ligament of the liver.

liver. A positive diagnosis could not be made, but an exploration was advised and accepted.

Operation, February 12, 1909, by Dr. W. J. Mayo: A median incision below the umbilicus was made, and upon opening the peritoneal cavity, a straw-colored, thin-walled cystic tumor, about the size of a child's head, presented immediately beneath the abdominal wall. The tumor was anterior to the omentum, which was found tucked up behind it. Putting in the hand to explore for the site of the attachment, it was found to be intimately associated with the abdominal wall, just above the umbilicus. The incision was ac-

cordingly elongated to two inches above the latter, by which means the cyst could be partially delivered outside the abdomen. Gauze dissection was used in freeing it from its pedicle, causing very little hemorrhage, as there were no vessels of any size running to it. It was then seen that the cyst had its origin in the lower two inches of the round ligament of the liver, where the latter is closely attached to the abdominal wall. The cyst was removed without rupture. A photograph was taken which is shown herewith (Fig. 75).

The patient's recovery was uneventful. He left the hospital on the twelfth day, and for his home in three weeks from the time of operation.

SURGERY OF THE LARGE INTESTINE, WITH A REVIEW OF ONE HUNDRED RESECTIONS *

BY WILLIAM J. MAYO

I. GENERAL CONSIDERATIONS

From the foregut we get the stomach and duodenum to a point below the common duct, the liver, and the pancreas. All of these organs derive their nourishment from the celiac axis and are concerned in the preparation of food for absorption, but do not themselves absorb. Morphologically, the small intestine begins at the pylorus, functionally at a point beyond the common duct.

The derivatives of the midgut are concerned in absorption and assimilation, and extend from the middle of the duodenum to the splenic flexure of the colon, where the hindgut begins and corresponds to the area of distribution of the superior mesenteric artery.

Ninety per cent. of the solids are picked up in the jejunum and ileum, and about half of the fluids are absorbed there. Ten per cent. of the solids and the balance of the fluids are absorbed in the large intestine proximal to the splenic flexure, largely in the cecum. A physiologic contraction between the cecum and ascending colon, at the situation of the cecocolic sphincter in certain lower animals, holds the material between this point and the ileocecal valves during absorption, and accounts for the localized cecal distention with gas and fluids noticeable on palpation in diarrheal disturbances. The fluids ingested, and also those secreted by the liver and pancreas, are used to keep the ingesta thin and in close contact with the valvulæ conniventes, and to mechanically float the residue finally into the cecum, where fluidity is no longer necessary and where it is re-absorbed. The chemical change from alkalinity to acidity of the material upon entering the large

* Read before the American Surgical Association, June 5, 1909. (Reprinted from "Annals of Surgery," July, 1909.)

intestine, a change which is connected with bacterial action, causes the formation of gases which play an important part in the further progress of the residue in the large intestine.

Differentiation between the midgut and the hindgut is not so well marked as between the foregut and the midgut (Young-Robinson). The hindgut gives rise to the descending colon, the sigmoid and rectum to the anal canal, and is supplied by the inferior mesenteric artery. Except during defecation the normal intestinal movement in this portion of the intestinal tract is anti-peristaltic, so that fluids introduced into the rectum, as in Murphy's proctoclysis, are carried backward for absorption above the splenic flexure, only a small amount being taken up by the derivatives of the hindgut, although many drugs and chemicals may be absorbed here. Bond has shown that solid particles when placed in the rectum are also carried upward by what he calls "reverse mucous currents." The descending colon, which marks the beginning of the hindgut, is usually found empty, and acts as a passage-way between the physiologically active midgut and the passive sigmoid. The function of the latter is to act as a fecal container, which its trap-like curves enable it to do.

At the juncture of the fundus and the antrum of the stomach there is a physiologic muscular activity which takes the place of the antral sphincter in certain of the lower animals. From this point to the descending colon the control depends upon internal secretions and the sympathetic ganglia, and, while influenced by Auerbach's and Meissner's plexuses, this control is largely independent of the cerebrospinal nervous system, as the maintenance of the body is a primitive function and existed before the development of the cerebrospinal system.

In the eleventh week of fetal existence the large intestine shows the cecal bud beginning to contract at its extremity, the site of the future appendix. The intestinal tube, which has been straight, has developed the U-shaped loop connected with the yolk-sac by the vitelline duct close to its middle. The remains of this duct may give rise to a Meckel's diverticulum which, if present, is usually to be found in the lower ileum within two or three feet of the ileocecal

valve. At the third month the entire large intestine is still to the left of the median line; but by the fourth month the head of the colon has rotated across the superior mesenteric artery and duodenum, and lies underneath the liver, to reach its normal situation soon after birth. During this rotation the contraction of the large herbivorous-like cecum into the carnivorous type is rapid, and the appendix is one result. Failure of complete rotation of the large intestine accounts for those cases of appendicitis on the left side or under the liver.

According to Ribbert, at birth the appendix is one-tenth the length of the large intestine, and in the adult, one-twentieth. Birmingham gives the length as one-sixteenth at birth and one-twentieth in the adult. Up to six years of age the normal appendix always contains a lumen, but after this time there often begins an involution with obliteration of the lumen from the tip toward the base. Ribbert states that in adults thirty-five years of age 25 per cent. of appendices are completely obliterated, and at seventy years of age one-half or more are obliterated. Birmingham's investigations do not bear out Ribbert's claims. He states that only 3 to 4 per cent. of adults have completely obliterated appendices, but that 25 per cent. of young adults and 50 per cent. at the age of fifty show partial obliteration. Our observations agree with those made by Birmingham.

Irregular obliteration, producing dams and strictures along the lumen of the appendix, is undoubtedly an important factor in the sedimentation which produces those fecal concretions which play so important a rôle in the causation of appendicitis.

Berry believes that the appendix is an important organ containing lymphoid structures like Peyer's patches, and that the tendency to obliteration seen in adults is the normal atrophy of lymph organs which occurs after the growing period of the individual has been accomplished.

Macewen and Keetley deprecate the present tendency to remove the appendix unless absolutely necessary to save life, believing that its removal tends to cause constipation and other colonic diseases. Keetley goes so far as to advocate the practice of opening up the

appendix, removing stones if they are present, evacuating abscesses, and finally burying the remnant of the organ in the abdominal wall to prevent future chance of peritonitis, thinking thus not only to maintain the function of the appendix, but to enable its later use for appendicostomy should colonic inflammation or obstinate constipation supervene. I am unable to concur in this opinion, as I cannot believe that an organ of such exceptional value as they state the appendix to be would so early become atrophied were it endowed with so great a function. At best, the saving of a functionally useless organ which is diseased so as to contain abscesses, stones etc., is not in harmony with modern views. We are only just beginning to recognize that serious functional digestive disturbances, such as pyloric spasm (appendiceal dyspepsia), colitis, etc., are often produced by a chronically diseased appendix.

It is evident that constipation most directly concerns the sigmoid and that its function as a fecal container is a comparatively late evolution. This is shown by the great variations in its length, size, and shape (Finney). The fact that the sigmoid, like the fundus of the stomach, is more or less under conscious control of the cerebrospinal nervous system also indicates a late development.

In the "Annals of Surgery," December, 1900, the writer called attention to certain varieties of constipation having primary origin in the small intestine, due to congenital or acquired narrowing at the ileocecal orifice, and reported several cases relieved by operation. Further experience has strengthened the opinion therein expressed. An obstinate constipation may depend upon too prolonged retention of the ingesta in the small intestine, interfering with proper chemical changes.

The head of the colon is extensively sacculated and of large capacity, but gradually diminishes in size, and in the descending colon and sigmoid the sacculations are primitive (Fig. 76). The diameter of the sigmoid is less than one-half that of the cecum. The longitudinal bands of muscle have, however, gradually increased in width and strength until at the juncture of the sigmoid and

rectum, they practically surround the intestine, and a complete investment extends down about the rectum, showing the increased muscular pressure which is necessary to propel non-liquid contents. Defecation is accomplished largely by siphonage, which usually completely empties the sigmoid. A hardened mass of feces forms the apex of the stool-mass, which is set in motion by the abdominal muscles compressing the intestinal gases. The normal rectum in the quiescent state contains feces only temporarily, as is shown by the examination of a large number of males for the army service. In the female, and sometimes in the male, an acquired tolerance may be found, and the rectum may contain chronically more or less hardened feces.

Treves in 1885 and Jonnesco in 1889 called attention to the inaccuracy of the anatomic description of the lowest sigmoid and first portion of the rectum, showing correctly, as I believe, that the so-called "first portion of the rectum" should be considered the terminal portion of the sigmoid down to the ending of the mesenteric attachment at about the third sacral vertebra. Here the rectum begins, and extends to the anal canal, which lies below the levator ani muscle. Embryologically, the true rectum has its origin from the highly differentiated lower part of the hindgut called the *cloaca*, which forms the bladder and rectum. This primitive association is of importance in the study of malignant disease.

Symington has made careful studies of the lower rectum and points out that the anal canal, about 1 to 1½ inches in length, is completely invested with muscle and has its origin in the proctodeum, and for this reason in cancer of this locality the inguinal glands are liable to be involved as well as the perirectal.

British anatomists divide the sigmoid into two portions: First the iliac, 5 to 6 inches in length, extending from the descending colon to the brim of the true pelvis, and having, if any, a very limited mesentery. Second, the pelvic portion, which averages 16 to 18 inches in length, has a long mesentery, and loops across the median line. Cunningham states that in 92 per cent. of subjects the pelvic sigmoid lies in the true pelvis after death. There is no question but that this description is more accurate and is based on a better

understanding of the anatomy than that which is ordinarily accepted in this country (Fig. 76).

The large intestine is from 5 to 5½ feet in length, and is about one-fifth of the intestinal tract.

The cecum and appendix are ordinarily completely invested by peritoneum. The transverse colon, which, including the hepatic and splenic flexure, is about 20 inches in length, and the pelvic sigmoid, have a well-developed mesentery. The ascending and descending colon and the iliac sigmoid are more or less closely attached to the posterolateral parietes.

The ascending colon, averaging from 7 to 8 inches in length, has an insecure attachment to the posterior muscles in its retroperitoneal extent, and upon this the weight of the ileocecal coil is suspended. The result of the traction tends to loosen the ascending colon from its bed, leaving a pouch into which the right kidney often prolapses, the descent of the kidney being aided by the attachment of the colon to Gerota's capsule and the so-called "nephrocolic ligament." On the left side this does not obtain, as the descending colon and the iliac sigmoid are closely attached in their retroperitoneal extent and give a weight-bearing space of from 12 to 14 inches.

Under normal conditions, as shown by Monks, the lowest ileum lies in the pelvis, the last 8 inches ascending from the pelvis to the cecum, and its terminal 2 inches is closely attached on the cecal side (Fig. 79). This attachment takes place early in fetal existence, so that, as a rule, the base of the appendix will be found within three-fourths of an inch of the ileocecal orifice. The lop-sided appearance of the cecum is due to the development of sacculations, which more easily occur on the free side. The terminal 6 inches of the ileum has the same blood-supply and lymph drainage as the cecum, through the ileocecal vessels. For this reason, in all cases of malignant diseases of the cecum, the appendix and terminal 6 inches of the ileum must be removed. Occasionally a lymph-gland will lie in the meso-appendix, and if so, lymph drainage from the right ovary and tube may find its way into it through Clado's ligament.

The ascending colon is supplied by the right colic artery, a branch of the superior mesenteric, anastomosing below with the ileocolic and above with the branches of the middle colic. The lymphatic

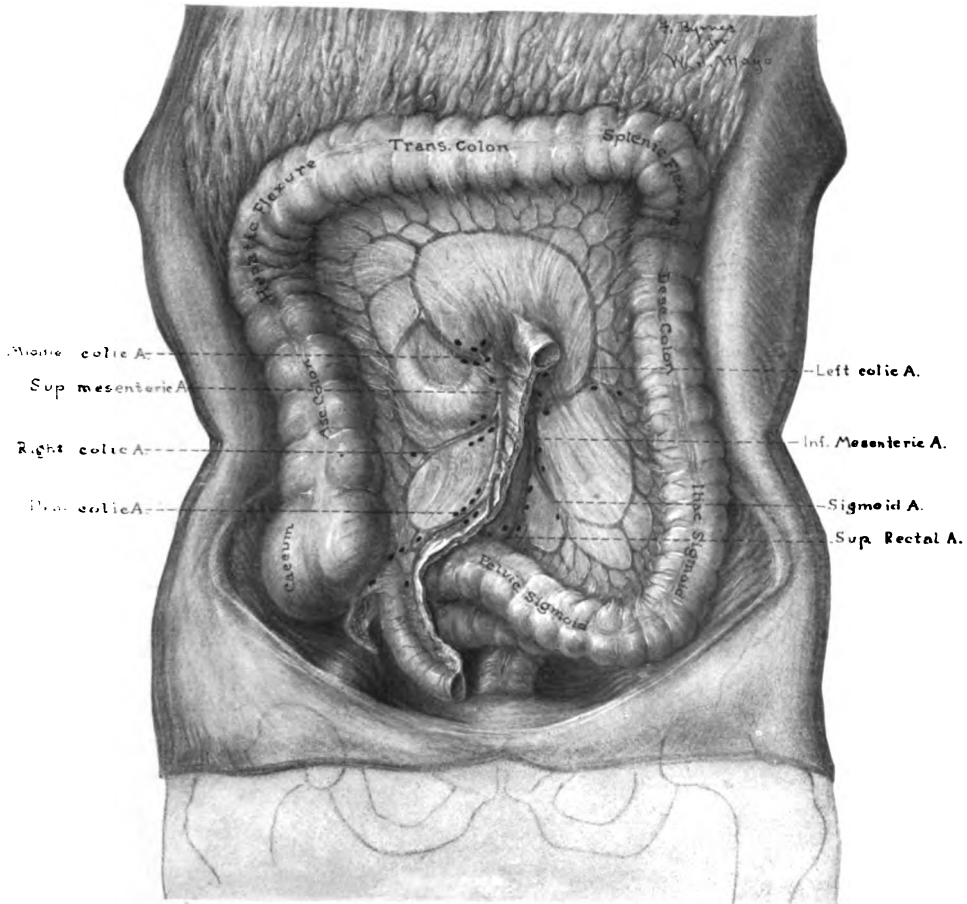


Fig. 76.—Anatomy of the large intestine. Note the relation of glands and blood-vessels.

drainage extends into the lymphatic glands at the base of the right colic artery and also in the ileocolic group. In carcinoma of the ascending colon it is necessary to remove the cecum and the terminal 6 inches of the ileum in order to secure the tributary lymph-nodes.

The middle colic artery comes from the superior mesenteric just below the pancreas, passing almost directly downward into the

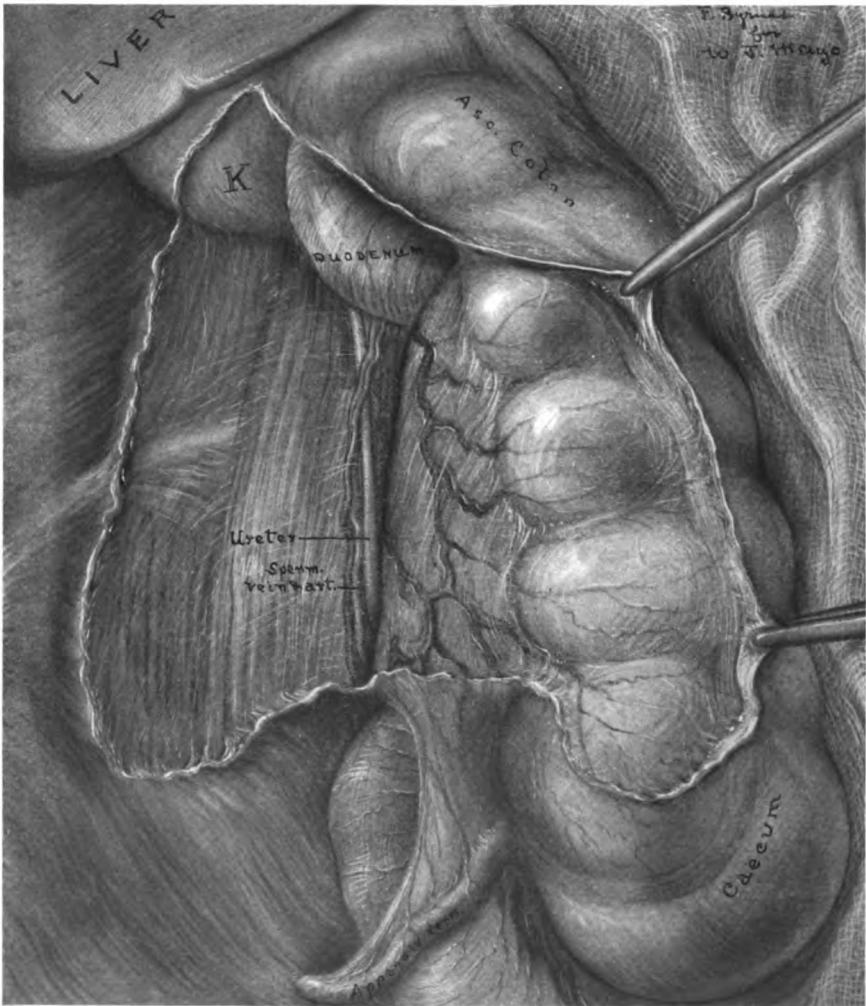


Fig. 77.—Mobilization of cecum and ascending colon. Note duodenum and ureter exposed.

transverse mesocolon, where it gives off large arterial arches to the right and left. The main arch passes to the left to anastomose

with the left colic, which arises from the inferior mesenteric. The middle colic is the main source of the blood-supply of the transverse colon, including the hepatic and splenic flexures, and while the anastomoses with the right and left colic suffice for the hepatic and splenic flexures respectively, Krönlein points out that in four cases out of five the transverse colon itself will not be nourished in its whole extent if the middle colic vessels are ligated. Injury to this vessel sometimes happens in resection of the stomach for cancer and may cause gangrene of the transverse colon.

The splenic flexure of the colon has a reduplication of the peritoneum derived embryologically from the omentum, which is sufficiently defined to be called the "costocolic ligament." The costocolic ligament has no large blood-vessels, and by division of it the splenic flexure is loosened from its deep situation and can be readily brought to the surface. The hepatic flexure has not this source of retention, therefore it is easily accessible, although there is often an extension to it of the duodenohepatic ligament.

The lymph drainage of the hepatic and splenic flexures as well as the transverse colon follows into the root of the transverse mesocolon. The lymph-nodes are in close communication with the deep lymph-chain along the aorta and about the head of the pancreas, and in malignant disease the accurate removal of the lymphatic-bearing mesentery is correspondingly difficult.

The left colic artery supplies the descending colon, but its anastomosis with the middle colic above and the sigmoid below makes extensive resections in this vicinity relatively safe. Fortunately, the lymph-supply diminishes rapidly from the ileocecal coil, and has reached its lowest ebb in the sigmoid. The very nature of the function of the colon, containing as it does virulent bacteria and toxic poisons, makes this lymph sparseness a necessity. Butlin has shown that over 60 per cent. of the deaths from cancer of the colon take place from obstruction or other causes before there is general metastasis, and many times, if enlarged glands are present, they will be found inflammatory.

The tendency of the lymph drainage of the descending colon is

toward the inferior mesenteric group of glands by way of the left colic vessel.

The sigmoid derives its blood-supply from the sigmoid artery, a branch of the inferior mesenteric, and anastomoses freely above with the left colic, and below with the superior rectal. The lymph drainage follows the vessels, and Moynihan points out that the highest lymph-node lies at the origin of the inferior mesenteric vessel. It would appear necessary, therefore, in operating for carcinoma of the sigmoid to resect extensively so as to remove the Moynihan gland with the mesentery, although this may necessitate destruction of the inferior mesenteric vessel with its tributary intestine.

The terminal portion of the sigmoid, the so-called "first portion of the rectum," is supplied by the superior rectal artery, which communicates freely with the middle hemorrhoidal arteries. The lymph drainage follows the superior rectal vessel, which is the direct continuation of the inferior mesenteric, and to secure the highest lymph-node at the origin of the inferior mesenteric, it may become necessary to ligate this vessel and remove the devitalized colon, possibly almost to the splenic flexure.

In estimating the feasibility of removing malignant disease of the large intestine the examination of the liver for embolic carcinoma should not be forgotten. In our experience, hepatic secondaries have been a larger cause of contraindication to radical operation in mechanically removable tumors than inoperable glandular metastasis.

By rectal touch the peritoneal sac can be felt anteriorly at the rectovesical fold. Carcinoma of any viscus in the peritoneal cavity may permit detachment of carcinoma cells, which gravitate into the cul-de-sac and graft upon the adjacent sigmoid, giving rise to the characteristic nodules which indicate the nature of the primary and possibly unlocated disease.

There are a number of fossæ in connection with the large intestine which may occasionally have surgical importance. They are due to faulty blending of the peritoneum with the large intestine, giving rise to small pockets extending up behind the bowel.

There are several of these recesses about the cecum in which the appendix is occasionally found.

This faulty blending of the large intestine with the peritoneum is well shown on the right side, the peritoneal sac being well developed before the cecum and ascending colon reaches its normal position, which does not occur until at or near birth. The result is that the attachment of the head of the colon to the parietal peritoneum is of a veil-like nature, resembling adhesions.

The entire large intestine is covered with a greater or less number of appendices epiploicæ, and in the obese these epiploic tags may reach considerable size. As a result of injury or local peritonitis they sometimes become attached to the parietes or neighboring structures, causing fixation of the intestine, or a band may be the cause of obstruction. Torsion may occur, with necrosis. We have met with two examples of this condition.

II. SURGICAL CONSIDERATIONS

Preparation.—Perhaps no factor has proved of greater importance to the human race than the sterilization of food by cooking. While the secretions of the stomach itself outside of the stomach do not have marked bactericidal properties, it should not be forgotten that bacteria are vegetable organisms, and that the digestive power of the stomach acts to destroy the bulk of the microörganisms introduced, so that the contents of the duodenum and upper jejunum, as shown by Adami and Cushing, are relatively sterile. This is shown clinically by the higher percentage of recoveries from perforations, gunshot injuries, etc., in the stomach, duodenum, and jejunum, as contrasted with the ileum and colon.

The ileum contains a rapidly increasing number of bacteria, and the lower two feet teem with virulent organisms. In the colon bacterial growth is marked and adds materially to the bulk of the stool. Hochenegg points out that liquid stool contains very active bacteria, especially the colon type, and therefore catharsis should not immediately precede operation upon the colon. The bowel should be thoroughly emptied forty-eight hours preceding operation, giving at least twenty-four hours for the intestine to become

quiet. This is also advisable because of the greater ease of dealing mechanically with the bowel if its contents are semi-solid rather than fluid.

Obstruction.—The most important feature of surgery of the large intestine, taken as a whole, is the question of obstruction. The mortality of necessary operations can be closely measured by the degree and acuteness of this condition.

It happens, unfortunately, that in some cases of tumor the first important symptom is an attack of acute obstruction. This is particularly true of tumors of the sigmoid, where the lumen of the intestine is more limited and the contents of a more solid nature. The obstruction interferes with the vitality of the distended intestine, renders it difficult to obtain proper asepsis during operation, and if resection is decided upon, there may be considerable trouble in uniting the distended to the collapsed segment of bowel. If the condition is acute, the absorbed toxins depress the heart's action and the abdominal distention interferes with the action of the diaphragm; if chronic, the interference with the progress of the food causes indigestion, nausea, gas, and abdominal distention. In suspected tumors of the large intestine careful examination should be made to arrive at a diagnosis before the stage of obstruction is reached. In the majority of instances the patient will have had symptoms upon which an early diagnosis of beginning obstruction can be made. There is, first, irregular bowel action, alternating constipation and diarrhea, with an unsatisfied feeling after stool, the movement failing to give complete relief. Second, cramps in the abdomen, attended by borborygmus, and *the patient will nearly always be able to locate the site of obstruction*, as it will be found at the point where the internal pressure is most intense. Third, on palpation the peculiar localized stiffening of the intestinal wall on the proximal side of the structure gives a "tumor-like feel" to the examining fingers, which appears and disappears, and is usually accompanied by gurgling of fluids and gases at the point of obstruction. Complete relaxation without anesthesia can usually be obtained in the hot-water bath, and a tumor, if present, can be detected. In low-lying tumors the sigmoidoscope may reach the

growth. Several times I have found a sigmoid tumor prolapsed into the rectum following a large soapy water enemata, so that it could be felt with the examining finger.

The danger of drowning from the regurgitation of intestinal contents during anesthesia should not be forgotten, and every case of obstruction should have the stomach emptied previous to operation. As a matter of fact, by careful attention to emptying the stomach and the use of saline enemata, a great many patients can be tided through a serious attack of obstruction, and the operation performed later under more favorable conditions.

The Incision.—In proposed resection of the large intestine the incision should be placed to the inner side of the seat of the disease. If the diagnosis has not been established, it is best to make a median incision through which the hand can be used to explore the abdomen. A second working incision can then be made at the most convenient situation. The utmost care must be taken to prevent infection from intestinal contents. If the proximal gut is greatly distended, it will be best to make a temporary incision into it at a point where the mesocolon is sufficiently long to allow its being drawn well out of the abdomen, and with a tube empty the contained material after the method of Monks. Treves states that emptying the distended intestine at a point above the obstruction has reduced the mortality of operations one-half in acute conditions.

Mobilization.—The most important technical feature is mobilization of the large intestine for purposes of operation. The large intestine has a very long mesentery, because all of its blood, nerve, and lymph supply lies in the inner leaf of the mesentery and arises from the abdominal aorta and vena cava or in that vicinity. It is true that the outer leaf of the mesentery is exceedingly short, if not absent, in the ascending and descending colon and iliac sigmoid; but as the outer leaf contains no structures of importance, it is only necessary to divide it, lift the colon from its bed, and swing it on its inner leaf to the midline. Therefore, the *sine qua non* for efficient operation is to locate the lesion, divide the peritoneal reflection to the abdominal wall, which mobilizes the part and allows it to be completely drawn outside of the abdomen, where it can be ade-

quately surrounded with aseptic pads for clean work. By holding the colon up to the light, the blood-vessels can be identified in the inner leaf of the mesentery, and caught, tied, and divided. Mr. Moynihan shows that even the descending colon may be mobilized in this way so that it can be anastomosed with the rectum or even brought down to the sphincter muscles. The transverse colon can be readily mobilized by dividing the gastrocolic omentum.

In separating the colon and ligating the blood-vessels there are some structures that must be identified.

First, the *duodenum*, a portion of which is bared in making a proper exposure of the ascending colon and the hepatic flexure. For this reason great pains should be used in the ligation of the right colic and right branches of the middle colic vessels, so that the duodenum will not be injured or caught in the teeth of the forceps during operation (Fig. 77).

Second, the *ureters* must be identified and separated from adherent growths of the ileocecal coil and ascending colon on the right side, on the left from the descending colon, and especially from the sigmoid. It must not be forgotten that just after the ureters cross the common iliac vessels they are adherent to the peritoneum, and that as the colon is mobilized and pushed toward the median line, the ureters go with it. Almost invariably the left ureter will be carried with the sigmoid and should be identified and separated before the resection is commenced (Fig. 77).

Third, the *vasa deferentia* are closely associated with the lowest sigmoid and rectum, and while not so important, they should be protected from accidental injury.

The mobilization of the lower sigmoid is readily effected by incisions along the broad ligament just under the ovaries and tubes in the female, or at the same situation in the male. These are joined by a transverse incision at the bottom of the Douglas pouch. By identifying and separating the ureters this entire portion of the bowel can be lifted cleanly from the hollow of the sacrum. The superior rectal artery comes readily with the intestine, but the middle sacral, which is usually present, and may be of considerable size, must be caught and tied.

In the removal of malignant growths of the large intestine it will sometimes be found that a neighboring viscus has become involved and is attached to it. If conditions otherwise are favorable, this should not be looked upon as a contraindication to operation. We have in such cases five times resected portions of the small intestine, on two occasions resecting two entirely independent loops of ileum, and after completing the resection of the small intestine we have removed the diseased colon with the fragments of small intestine attached. Twice we have removed portions of the stomach which were attached to tumors of the transverse colon, and three times the bladder has been involved, necessitating partial removal of the bladder wall. One of these cases was very interesting because of the now three-year recovery of the patient after the removal of a considerable portion of the bladder-wall, which was attached to and involved in a low-lying sigmoid cancer. Quite frequently in the female the ovaries, tubes, and uterus become attached to sigmoid growths, and it adds but little to the difficulties and dangers of the operation to remove these attached organs from before backward in one mass with the original disease.

Method of Anastomosis.—In our experience it has made comparatively little difference by what method the anastomosis was accomplished as long as the opening was large enough. Granting that end-to-end intestinal union is ideal, the result of the lateral, or end-to-side, have been, functionally, just as satisfactory. In union between the large and small intestine we have usually made the lateral operation by suture, leaving as small a pouch as possible beyond the opening—and it seems to be quite immaterial whether it is made isoperistaltic or antiperistaltic—whichever way the intestine will come together without angulation or traction; but in lateral union between two parts of the large intestine the resection should be isoperistaltic and the openings brought close to the stump ends so as not to leave a distal pouch. Ileocolostomy is the safe operation because the contents of the ileum are fluid as compared with the solid or semi-solid character of the matter in the colon.

In end-to-end resection of the large intestine it is rather necessary

for a safe anastomosis that at least one of the fragments should be well surrounded by peritoneum. In the ascending and descending colon and the iliac sigmoid the inadequacy of the peritoneal covering may result in fistula formation, a condition which is most troublesome to heal.

For this reason in like cases resection of the sigmoid has a much higher mortality than resection of the cecum.

The lateral operation gives very satisfactory results in such cases. If there is marked obstruction and distention, the three-stage operation of Mikulicz and Paul has much to commend it. At the first operation the tumor, with the mesentery and glands well detached, is drawn out of the wound and the proximal and distal loops united by sutures. The part to be excised is then, if possible, drawn through a separate incision in the abdominal wall of just sufficient size to carry it easily and hold it in good position. The peritoneum is united by a few interrupted sutures to the two limbs of the intestine on the inner aspect. If the symptoms of obstruction are severe, a small incision is made in the exposed mass proximal to the obstruction, and a rubber tube is introduced through which the intestinal contents are carried into a receptacle. The tumor with the attached intestine is cut away on the third to fifth day and a heavy clamp applied to the spur on the twelfth to sixteenth day; this bites its way through about six days later.

Of late, we are doing the three-stage operation less frequently, as it does not permit of such extensive and careful dissection as is necessary for the removal of the lymph-channels, and the patient is subjected not only to a tiresome convalescence and unpleasant external fecal discharge for a number of days, but a secondary operation may become necessary for complete cure on account of fecal fistula.

In all resections we now use the two-row suture method with holding-clamps, and I would say again that the importance of the method of anastomosis, whether end-to-end, side-to-side, or end-to-side, has been exaggerated. The more nearly the intestine approaches the normal, the better the prospects of end-to-end anastomosis, but with a distended intestine from obstruction, the

less the mesenteric attachment is handled the better, and the lateral method is safe and satisfactory. On several occasions I have had an opportunity to see the result of lateral anastomosis after one year or more, and only a small elbow, at most, marked the site of the union.

In making resections one is not always satisfied with the appearance of the bowel union, and fears leakage. We have in several instances fastened the anastomosed part to the peritoneum, just underneath the incision, carrying down to it strips of rubber tissue so that if leakage occurred, it could readily make its way to the surface, or the entire anastomosis can be suspended on a roll of rubber tissue in such manner that in a few hours it will become protected by adhesion to the peritoneum at the site of the abdominal wound. Gauze should not be used for this purpose, as it becomes entangled in the plastic lymph and is quite often followed by fistula.

There is a group of low-lying sigmoid tumors which are exceedingly difficult to get at and where a combined abdominal and perineal operation becomes necessary. As a rule, the whole of the rectum must be removed and the sigmoid attached to the anal muscles, although occasionally the cut end can be united directly to the rectal stump by the method of Tuttle, Maunsell, or Weir. After direct union between the sigmoid and rectum, we have passed a three-fourth inch rubber tube with an oblique end and lateral eye from the anus upward into the sigmoid several inches above the union, and fastened it by a suture to the anal margin. This tube is left from four to ten days to carry gas and feces by the suture line. In two cases of this type we closed the end of the rectum completely, leaving it as a pouch, and made a permanent left inguinal colostomy.

The abdominoperineal operation for low-lying sigmoid growths has been unusually fatal in fleshy males. On two occasions, in males weighing 200 pounds or more, we have removed the tumor by the posterior route, by an incision which passed from the anus upward along the left side of the sacrum, excising the coccyx. The

anus was closed with sutures and the rectum dissected out of its muscular bed. The peritoneum was opened in front and the entire rectum with the fat and glands lifted from the seminal vesicles, prostate, and bladder. By lateral incisions the peritoneum was separated and the rectum, tumor, and necessary sigmoid amputated, the proximal end of the sigmoid carried down to and sutured into the muscles below. We have followed the recommendation of Peck and left the distal end of the sigmoid closely sutured for four to seven days following operation. In this way we have obtained complete primary union and had a fair muscular control in four weeks.

One would suppose that complete obstruction of the intestinal stump for several days would lead to great distress, if not to more serious effect upon the patient, but if the bowel is allowed to become quiet for twenty-four hours before operation, and if during the time of complete obstruction the patient is kept on albumin water, strained soups, etc., the majority will go three or four days, or more, without much trouble. This effect can be continued for a day or two longer, if the gas pressure becomes great, by putting a small cannula with a rubber tube attached into the projecting sigmoid stump, to carry off the gas.

In several low-lying carcinomata in the female, where the patient was very much reduced from bleeding and sepsis, we have done the Quénu-Tuttle perineal resection of the entire rectum and lower sigmoid with satisfaction.

I am quite well aware that the posterior and perineal routes are not to be recommended for sigmoid tumors, but in the obese and the very anemic, operations of this type are well borne, and have, in our hands, been followed by complete recovery.

Trying it for the first time in these cases one will be surprised at the ease and safety with which the rectum, sigmoid, and tumor can be removed, together with the fat and glands, to a point as high as the promontory of the sacrum.

III. ONE HUNDRED CONSECUTIVE RESECTIONS OF THE LARGE INTESTINE IN THE ADULT

In the 100 resections there were 12 deaths, a mortality of 12 per cent. Most of the deaths were due to sepsis and exhaustion, and they illustrate the baneful influence of obstruction, which was present in nearly all of the fatal cases. This brings up the question as to whether preliminary colostomy or enterostomy is generally advisable as a preparatory measure in severe obstruction.

When it is possible, we prefer to resect at the primary operation, contenting ourselves with emptying the proximal side of the intestine of its contents. But if the intestinal wall is thickened and soggy, threatening the security of the suture line, a preliminary colostomy is advantageous. The opening is not, as a rule, closed at the time of resection, but is allowed to remain open as a safety-valve and closed later if necessary.

Of the 100 resections, 61 were for malignant disease, with 8 deaths, and 39 for benign conditions, with 4 deaths. Surgically speaking, it is wise to consider malignant disease of the colon in three anatomic groups:

Group I.—Cancer.—The cecum and ascending colon was removed for cancer 24 times, with 3 deaths; 23 were carcinoma, with 2 deaths; and 1 was sarcoma, with no operative mortality.

Group II.—The transverse colon, including the hepatic and splenic flexures, was removed for carcinomatous neoplasm 7 times, with 1 death.

Group III.—The descending colon and sigmoid were excised for carcinoma 30 times, with 4 deaths.

GROUP I.—The Cecum (Figs. 78 and 79).—The ascending colon is classed with the cecum because many cancers involve the margin of the ileocecal orifice and extend upward into the ascending colon and downward into the cecum, therefore possibly involving the ileocolic and right colic group of glands.

The first step in the resection of the head of the colon is to liberate the cecum and ascending colon by an incision through the outer peritoneal attachment. With a piece of gauze the intestine, with the tumor and fat, is wiped cleanly to the muscles as far as the

superior mesenteric origin of the ileocolic and right colic vessels, which are tied at once, enabling a sure dissection of the mesenteric glands and fat.

The greater ease and safety with which union between the small and large intestine can be secured, as contrasted with resection in continuity of the colon, is of great technical advantage. This is

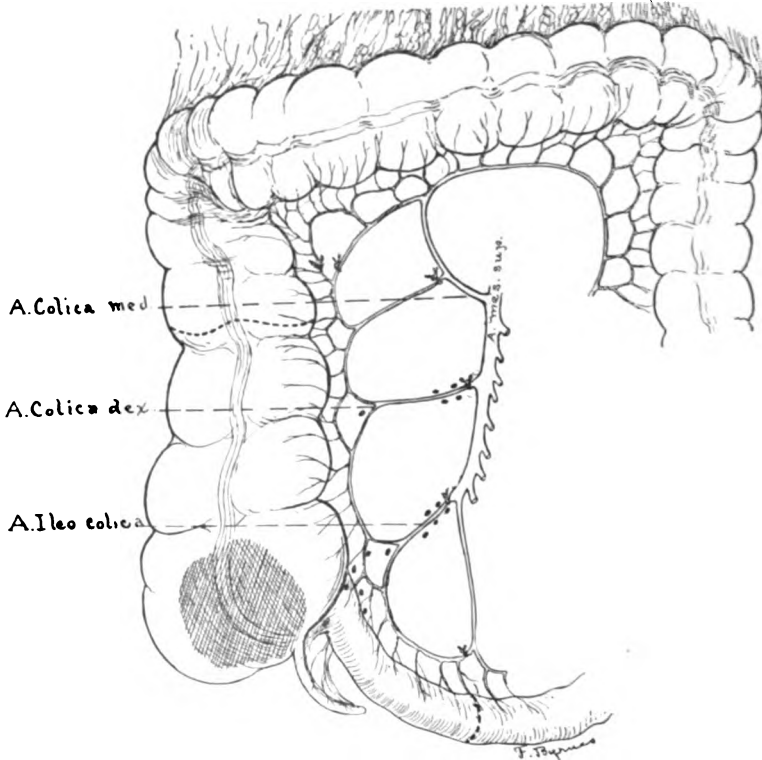


Fig. 78. — Carcinoma of cecum. Dotted lines show lines of resection.

equally true of resection of the hepatic flexure. Looked at from a purely technical standpoint, a carcinoma existing at any point between the ileocecal orifice and the juncture of the right with the middle two-thirds of the transverse colon can be most safely treated by complete resection of all the large bowel up to that point, and this also most effectually removes the lymphatics.

In carcinoma of the cecum it is necessary to remove the ileocecal group of glands with the ileocecal mesentery, and, therefore, not less than the terminal 6 inches of the ileum must be excised. The ascending colon should also be excised in order to secure the right colic vessels and tributary glands.

The type of disease was usually found to be *adenocarcinoma* and the ileocolic glands were nearly always affected. In some specimens the disease appeared to have had its origin in the appendix. However, the appendix was so thoroughly involved as to make it impossible to arrive at any accurate conclusion on that point.

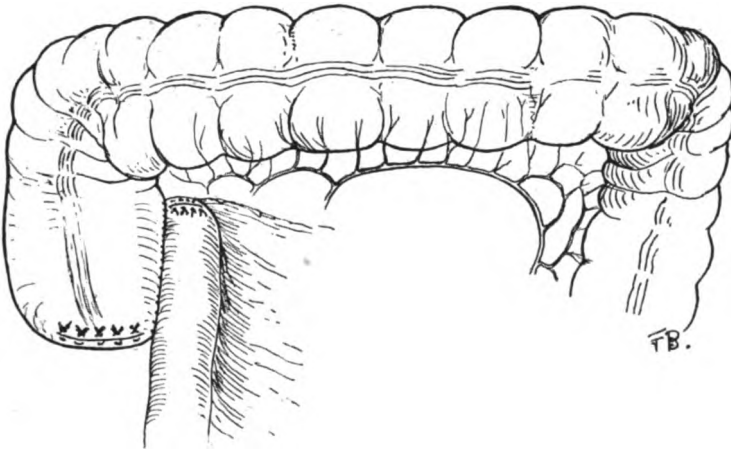


Fig. 79.—Lateral anastomosis following excision of cecum and ascending colon, between lower ileum and hepatic flexure.

In the past three years we have operated upon and recognized microscopically six cases of primary appendiceal carcinoma, one-fifth of one per cent. of the total operations for appendicitis in that time. As pointed out by Harte, cancer of the appendix is usually of small size—not larger than a pecan nut. It is seen most frequently in the second and third decades, as contrasted with adenocarcinoma of the cecum, which is most frequent in the fourth and fifth decades of life. Primary carcinoma of the appendix is of the spheroidal or basal-cell type. It seldom involves the lymph-nodes, although LeConte reports one such case. In two of our cases the

microscopic resemblance to endothelioma was striking. While in our cases of primary carcinoma of the appendix the cecum was usually partially resected, they are not included in the statistics, as the continuity of the intestinal canal was not affected by the operation.

GROUP II.—*Cancer of the Transverse Colon and Flexures* (Figs. 80 and 81).—In this group there were 7 cases with 1 death. The percentage of inoperable carcinomas of the transverse colon in which no operation could be done was higher than in any other

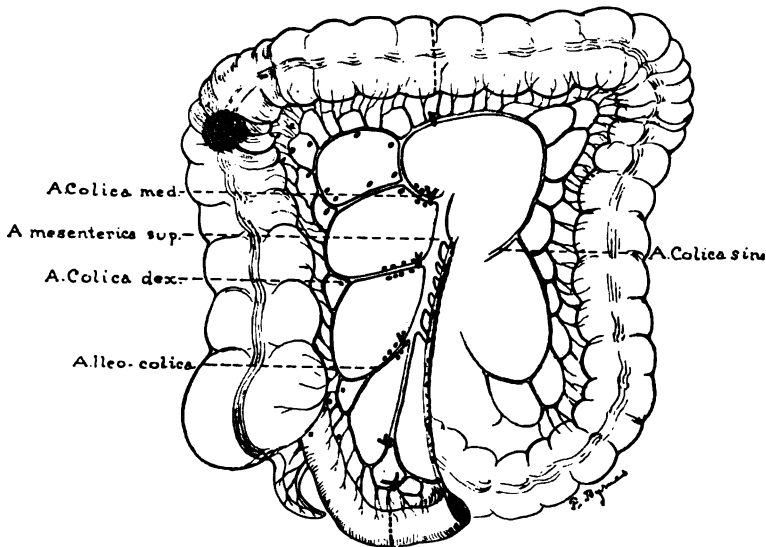


Fig. 80.—Cancer of hepatic flexure. Dotted lines show proposed resection.

group, as there appeared to be relatively early involvement of the lymph-nodes about the head of the pancreas.

In resections involving the middle of the transverse colon, the middle colic artery should be ligated early and the separation of the glands started with that vessel. This will at once show the extent of the devitalized colon which must be removed.

Involvement of the splenic flexure is prone to early and extensive adhesions, and local extension along these pathways of the carcinomatous process is a more frequent bar to resection than lymph

metastasis. If the costocolic ligament and the outer peritoneal attachments are divided as the first step of the operation, the splenic flexure is liberated, and with the glands and fat can be drawn well out of the abdomen, and early ligation of the right and left colics at proper points facilitates further manipulations.

GROUP III.—*Cancer of the Descending Colon and Sigmoid* (Figs. 82 and 83).—In this group there were 30 cases with 4 deaths. The

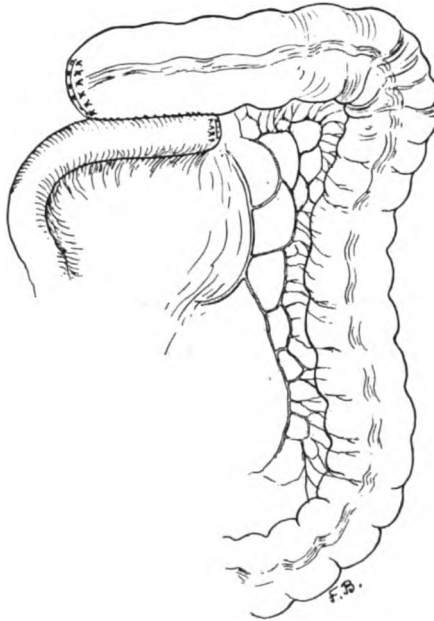


Fig. 81.—Lateral anastomosis following resection of hepatic flexure between lower ileum and transverse colon.

steps of operation are similar to those of the cecum and ascending colon. Liberation by division of the outer peritoneal folds, and early ligation of the blood-vessels at their origin, enables easy removal of the glands and fat, so that resection can be completed outside of the abdominal cavity. Ideal resections with complete removal of the lymphatic tributaries may necessitate ligation of the inferior mesenteric vessel on account of the importance of securing that gland, which, according to Moynihan, almost invariably lies

at its origin. Wide removal of the peritoneum and surrounding fat is as necessary as the removal of the glands.

Resections for Benign Disease of the Large Intestine.—Of the 39 resections for benign conditions, 2 involved the entire colon; both recovered. Twenty-four involved the cecum and ascending colon,

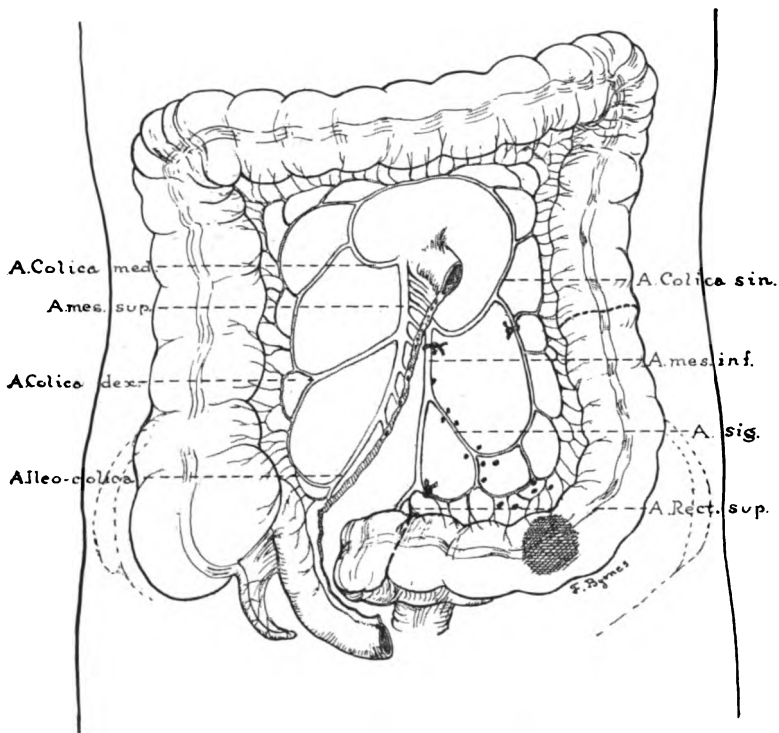


Fig. 82.—Cancer of sigmoid. Dotted lines show proposed resection.

with 1 death. There were 2 of the transverse colon, with 1 death, and 11 of the sigmoid, with 2 deaths.

GROUP I.—*Two Colectomies for Chronic Ulcerative Colitis.*—Nearly all the colon was removed; both made a good recovery.

GROUP II.—*Cecum and Ascending Colon.*—There were 24 resections of the cecum and ascending colon, with 1 death.

(a) *Inflammatory Disease* (11, with 1 death).—This group is made up of an assortment of inflammatory conditions in which the

continuity of the bowel had been destroyed by infection or its results, such as sloughing, causing large fecal anus at the ileocecal juncture, impossible of closure by plastic operation.

Three of the latter resections required simultaneous resection of the sigmoid because of previous attempts (not in our clinic) at closing the fecal anus by anastomosing the cecum to the sigmoid. Attempt to cure fecal fistula by performing lateral anastomosis, with the view that short-circuiting would permit the fistula to heal,

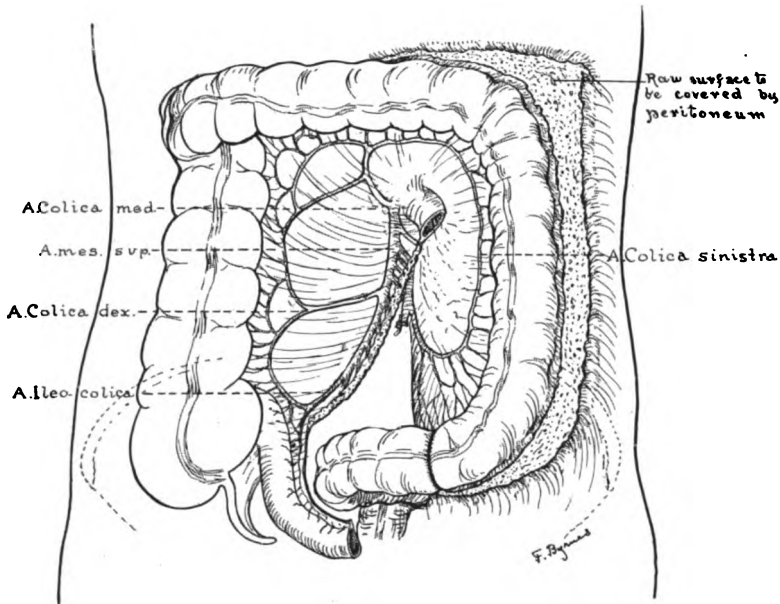


Fig. 83.—End-to-end anastomosis following resection of sigmoid. Note mobilization of splenic flexure and descending colon.

is usually a mistake. If there is no obstruction, the vermicular action of the intestine constantly tends to carry the ingesta past the artificial opening along the normal lines of the bowel, and not only is the patient not cured of the disease, but a serious complication is added when later it becomes necessary to operate for a definite cure of the lesion. It is a simple matter to circumscribe a fecal fistula by an incision down to the peritoneum at some point outside of the intestinal adhesions and introduce the finger as a

guide. The less firm adhesions are swept loose and the circum-scribing incision deepened through into the peritoneal cavity. The intestinal loop containing the fistula can be drawn out upon the surface of the abdomen, surrounded with gauze, and the fistula closed in the long axis of the intestine by two rows of sutures, the outer row preferably of interrupted linen or silk.

(b) *Intussusception*.—A benign fibromyoma of considerable size, growing from the vicinity of the ileocecal valves and projecting into the lumen of the cecum, causing intussusception, was subjected to resection with cure.

(c) *Localized Tuberculosis* (12 cases with no deaths).—Tuberculosis of the ileocecal coil occurs in two forms—ulcerous and hypertrophic. Only one of the ulcerous type was subjected to excision, although a few patients were seen who, when they came under observation, were in a poor general condition, with extensive fistulous tracts associated with multiple tuberculosis in the small intestine, and usually with pulmonary involvement. Eleven of the resections were for hypertrophic tuberculosis with well-marked tumor, and in the majority it was difficult to differentiate them from carcinoma at the time of the operation.

In addition to these 12 cases in which resection for tuberculosis was performed, there were a number in which the local condition was looked upon as being inoperable, and some form of exclusion operation was made as a palliation for obstruction. This was particularly true in our early experience before we became aware of the extent to which these operations could be carried, also because we looked upon irremovable lymphatic glands as a contra-indication to resection. In several instances we have removed hypertrophic tuberculosis of the cecum with the ileocolic glands, and have left huge tuberculous glands extending up along the aorta as high as the diaphragm, their size varying from that of a walnut to an egg, with complete and permanent cure of the patient. Shutting off the supply of infection evidently enabled nature to overcome the poison which had already been absorbed into the glandular system. In several of the specimens the bovine type only of tubercle bacilli were found to be present.

In 54 cases, 1 per cent. of the total number of appendectomies, the appendix was the seat of tuberculosis. The cecum was nearly always involved at the base and extensively removed. These cases are not included in the statistics because the continuity of the bowel was not interfered with in the operation. Many were apparently the original focus of an extensive tuberculous peritonitis and the operation was undertaken for this symptomatic condition.

GROUP II.—*Resection of the Transverse Colon.*—The transverse colon was resected twice for benign disease—once for diverticulitis, and once for fibrolipoma, with 1 death.

GROUP III.—*Sigmoid.*—The sigmoid was resected 11 times, with 2 deaths. (a) In one case of Hirschsprung's disease, or giant colon, the sigmoid with the ascending and transverse colon was excised, with cure. (b) Fibrolipoma, 1 resection with recovery. (c) Two for tuberculosis, one of the ulcerous type and one of the hypertrophic variety; both recovered. (d) Five were for diverticulitis, with two deaths. This last-named condition is very curious, and is due to pouching of the mucous membrane through small defects in the muscular coat of the colon in which fecal concretions form and result in acute or chronic inflammation. A well-defined tumor is usually to be felt, which is tender during the acute stage and accompanied by mild general symptoms of infection. These tumors have often been diagnosed as carcinoma, and in three out of five resections for this condition in the colon the diagnosis was only cleared up with the microscope. (For a full report of five of these cases see article by Mayo, Wilson, and Giffin, in "Surgery, Gynecology, and Obstetrics," July, 1907.)

The sigmoid was resected for inflammatory pelvic disease twice, with recovery.

In the group of resections we have not included a considerable number in which the sigmoid was more or less involved or injured in the course of operation for diseases of the pelvic organs, as the consideration of these should be undertaken in connection with the diseased processes of which they were the accidental rather than a primary part.

I am indebted to Dr. M. S. Henderson for compiling the follow-

ing table of statistics from the records at St. Mary's Hospital, and also for the correspondence involved in ascertaining the present condition of the patients.

ONE HUNDRED CONSECUTIVE RESECTIONS OF THE LARGE INTESTINE IN THE ADULT.

(Operations Performed at St. Mary's Hospital, Rochester, Minnesota, Between February, 1898, and February, 1909.)

Of the 100 resections, 61 were for malignant disease, with 8 deaths (13 per cent.).

CANCER OF THE CECUM AND ASCENDING COLON.

Number of cases.....	24
Male.....	17
Female.....	7
Age of oldest.....	72
Age of youngest.....	31
Average age.....	48
Patients of ages between 30 and 40 years.....	7
Patients of ages between 40 and 50 years.....	11
Patients of ages between 50 and 60 years.....	2
Patients of ages between 60 and 70 years.....	3
Patients of ages between 70 and 80 years.....	1
Average duration of symptoms 13 months.	
Operative mortality..... (12.5 per cent.)	3
Patients dying within 1 year after operation.....	1
Patients dying between 1 and 2 years after operation.....	3
Patients alive less than 1 year after operation.....	2
Patients alive 1 to 2 years after operation.....	2
Patients alive 2 to 3 years after operation.....	3
Patients alive 3 to 4 years after operation.....	2
Patients alive 4 to 5 years after operation.....	1
Patients alive 5 to 6 years after operation.....	1
Patients alive 6 to 7 years after operation.....	1
Patients alive 7 to 8 years after operation.....	1
Number not located.....	3
Total.....	24

Of 11 patients operated upon more than three years ago, 10 have been traced. Six, or 60 per cent., are alive and well to date.

CANCER OF THE TRANSVERSE COLON INCLUDING THE HEPATIC AND SPLENIC FLEXURES.

Number of cases.....	7
Male.....	2
Female.....	5
Age of oldest.....	66
Age of youngest.....	35
Average age.....	52
Patients of ages between 30 and 40 years.....	1
Patients of ages between 40 and 50 years.....	2
Patients of ages between 50 and 60 years.....	2
Patients of ages between 60 and 70 years.....	2
Average duration of symptoms 16 months.	

CANCER OF THE TRANSVERSE COLON INCLUDING THE HEPATIC AND SPLENIC FLEXURES—(Continued).

Operative mortality.....	(14 per cent.)	1
Patients dying 1½ years after operation.....		1
Patients dying 2 years after operation.....		1
Patients alive and well 1 year after operation.....		2
Patients alive and well 3 years after operation.....		1
Number not located.....		1
Total.....		7

CANCER OF THE SIGMOID.

Number of cases.....		30
Male.....		21
Female.....		9
Age of the oldest.....		71
Age of the youngest.....		31
Average age.....		52
Patients of ages between 30 and 40 years.....		5
Patients of ages between 40 and 50 years.....		7
Patients of ages between 50 and 60 years.....		8
Patients of ages between 60 and 70 years.....		8
Patients of ages between 70 and 80 years.....		2
Average duration of symptoms 2 years.		
Operative mortality.....	(13 per cent.)	4
Patients dying 1 year or less after operation.....		3
Patients dying 1 to 2 years after operation.....		5
Patients dying 2 to 3 years after operation.....		1
Patients alive and well 1 year after operation.....		7
Patients alive and well 1 to 2 years after operation.....		5
Patients alive and well 2 to 3 years after operation.....		2
Patients alive and well 3 to 4 years after operation.....		3
Total.....		30

Out of 6 cases operated upon more than 3 years ago, 3, or 50 per cent., are alive and well.

RESECTIONS FOR BENIGN DISEASES OF THE LARGE INTESTINE.

Number of cases.....	(4 deaths—10 per cent.)	39
Colectomy for ulcerative colitis (nearly all of the colon removed).....		2
Cecum and ascending colon.....		24
Localized tuberculosis.....		12
Inflammatory disease.....		11
Intussusception.....		1
Transverse colon, including hepatic and splenic flexures.....		2
Diverticulitis.....		1
Fibrolipoma.....	(1 death)	1
Descending colon and sigmoid.....		11
Tuberculosis.....		2
Diverticulitis.....	(2 deaths)	5
Fibrolipoma.....		1
Hirschsprung's disease.....		1
Inflammatory disease.....		2
Total.....		39

TUMORS OF THE CECUM *

By WILLIAM J. MAYO

Tumors of the cecum can be divided into two groups—benign and malignant. The more common of the benign type, while not tumors in the sense that they are new-growths, are those occasioned by some form of infection:

First: A large amount of inflammatory tissue lying about an infected appendix or chronic cecal ulcer which has become buried in the wall of the cecum causing a mass that may be present for weeks or months. I have no doubt that surgeons other than ourselves have cut down upon such movable tumefactions expecting to find cancer of the cecum.

Second: The hypertrophic type of tuberculosis, which gives rise to an infected tumor and often cannot be differentiated from cancer except with a microscope. Such tumors, however, require resection for their cure, and a mistake in diagnosis is not of vital importance.

Third: Diverticulitis, which is an infrequent cause of cecal tumor. The usual situation of this condition is in the sigmoid. We have, however, had one typical case in the cecum.

Fourth: Two strange forms of benign cecal tumors are those due to the so-called angioneurotic edema and to its first cousin, the localized hemorrhage in the intestinal wall of Henoch, which is seen most often in children.

This paper will be devoted, briefly, to the second group—*malignant tumors of the cecum*.

* Read at the forty-first annual meeting of the Minnesota State Medical Association, held at Winona, Oct. 14 and 15, 1909. (Reprinted from "The Journal of the Minnesota State Medical Association and The Northwestern Lancet," December 15, 1909.)

In most instances carcinoma of the cecum has its origin close to the ileocecal valve, therefore involving the ascending colon as well as the cecum. The ascending colon, averaging from 7 to 8 inches in length, has an insecure attachment to the posterior muscles in its retroperitoneal extent, and upon this the weight of the ileocecal coil is suspended. The head of the colon is extensively sacculated and of a large capacity, but gradually diminishes in size, and in the descending colon and sigmoid the sacculations are primitive. The cecum and appendix are completely invested by peritoneum.

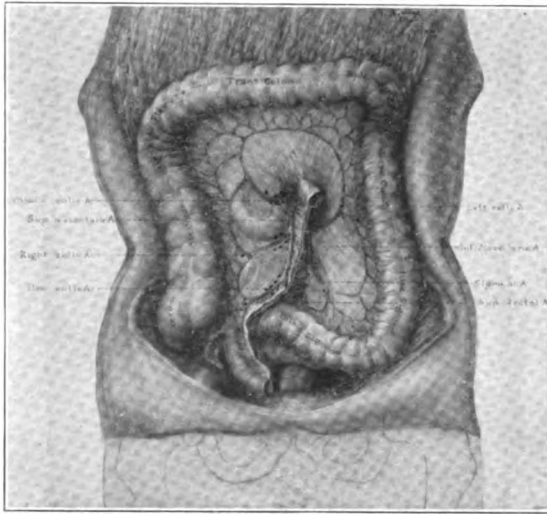


Fig. 84.—Anatomy of the large intestine. Note the relation of glands and blood-vessels.

Under normal circumstances, as shown by Monks, the lowest ileum lies in the pelvis, the last 8 inches ascending from the pelvis to the cecum, its terminal 2 inches being closely attached to the cecal side (Fig. 84). This attachment takes place early in fetal existence, so that, as a rule, the base of the appendix will be found within $\frac{3}{4}$ of an inch of the ileocecal orifice. The lop-sided appearance of the cecum is due to the sacculations which occur with greater ease on the free side. The terminal 6 inches of the ileum drains

into the ileocolic group of glands, and in cecal cancer should be removed. Occasionally a lymph-gland will lie in the meso-appendix, and if so, lymph drainage from the right ovary and tube may find its way into it through Clado's ligament.

The ascending colon is supplied by the right colic artery, a branch of the superior mesenteric anastomosing below with the ileocolic and above with the branches of the middle colic. The lymphatic drainage extends into the lymphatic glands at the base of the right colic artery and also into the ileocolic group. Therefore, for all practical purposes, malignant disease of the cecum and ascending colon may be considered as one (Fig. 84).

In estimating the feasibility of removing malignant disease of the cecum and ascending colon, the examination of the liver for embolic carcinoma should not be forgotten. In our experience hepatic secondaries have been a larger cause of contraindication to radical operation in mechanically removable tumors than inoperable glandular metastasis.

By rectal touch the peritoneal sac can be felt anteriorly at the rectovesical fold. Carcinoma of any viscus in the peritoneal cavity may permit detachment of carcinoma cells which gravitate into the cul-de-sac and graft upon the adjacent sigmoid, giving rise to the characteristic nodules, which indicate the nature of the primary and possibly unlocated disease.

Taken as a whole, the most important feature of surgery of the cecum and ascending colon is the question of obstruction. The mortality of necessary operations can be closely measured by the degree and acuteness of the condition.

It happens, unfortunately, that in some cases of tumor the first important symptom is an attack of acute obstruction. The obstruction interferes with the vitality of the distended intestine, renders it difficult to obtain proper asepsis during operation, and, if resection is decided upon, there may be considerable trouble in uniting the distended with the collapsed segment of bowel. If the condition is acute, the absorbed toxins depress the heart's action, and the abdominal distention interferes with the action of the diaphragm; if chronic, the interference with the progress of the food

causes indigestion, nausea, gas, and abdominal distention. In suspected tumors careful examination should be made in order to arrive at a diagnosis before the stage of obstruction is reached. In the majority of instances the patient will have symptoms upon which an early diagnosis of beginning obstruction can be made. There are, first, irregular bowel action, alternating constipation, and diarrhea with an unsatisfied feeling after stool, the movement failing to give complete relief; second, cramps in the abdomen attended with borborygmus, and the patient will nearly always locate the site of the obstruction, as it will be found at a point where the internal pressure is most intense; third, on palpation the peculiar localized stiffening of the intestinal wall on the proximal side of the stricture gives a "tumor-like feel" to the examining fingers, and this appears and disappears, and is usually accompanied by gurgling of fluids and gases at the point of obstruction. Complete relaxation without anesthesia can usually be obtained in the hot-water bath, and a tumor, if present, can be detected. Patients with cecal tumor often have a profound anemia without any apparent good reason for it.

In proposed resection of the cecum the incision should be placed to the inner side of the seat of the disease. If the diagnosis has not been established, it is best to make a median incision, through which the hand can be used to explore the abdomen. A second working incision can be made at the most convenient situation. The utmost care must be taken to prevent infection from intestinal contents. If the proximal gut is greatly distended, it will be best to make a temporary incision into it at a point where the mesentery is sufficiently long to allow its being drawn well out of the abdomen, and with a tube empty the contained material after the method of Monks. Treves states that emptying the distended intestine at a point above the obstruction has reduced the mortality one-half in acute conditions.

The most important technical feature in an operation for cancer of the cecum is the mobilization of the intestine for purposes of operation. The large intestine has a long mesentery. All of its blood, nerve, and lymph supply lies in the inner leaf of the mesen-

tery and arises from the abdominal aorta and vena cava, or in that vicinity. It is true that the outer leaf of the mesentery is exceedingly short, if not absent, in the ascending colon; but as the outer leaf contains no structure of importance, it is only necessary to divide it, lift the colon from its bed, and swing it on its inner leaf to the midline; therefore, the *sine qua non* for efficient operation is to locate the lesion and divide the peritoneal reflection to the abdominal wall, which mobilizes the part and allows it to be com-



Fig. 85.—Mobilization of cecum and ascending colon. Note duodenum and ureter exposed.

pletely drawn outside of the abdomen, where it can be adequately surrounded with aseptic pads for clean work (Fig. 84). By holding the colon up to the light, the blood-vessels can be seen in the inner leaf of the mesentery, and caught, tied, and divided.

In separating the cecum and ascending colon, and ligating the blood-vessels, there are some structures that must be identified: first, the duodenum, a portion of which is bared in making a proper

exposure of the vessels of the ascending colon. For this reason great pains should be used in the ligation of the right colic and right branches of the middle colic vessels, so that the duodenum will not be injured or caught in the teeth of the forceps during operation (Fig. 85). Second, the right ureter must be identified and separated from adjacent growths of the ileocecal coil and ascending colon (Fig. 85).

In the removal of these malignant growths it will sometimes be

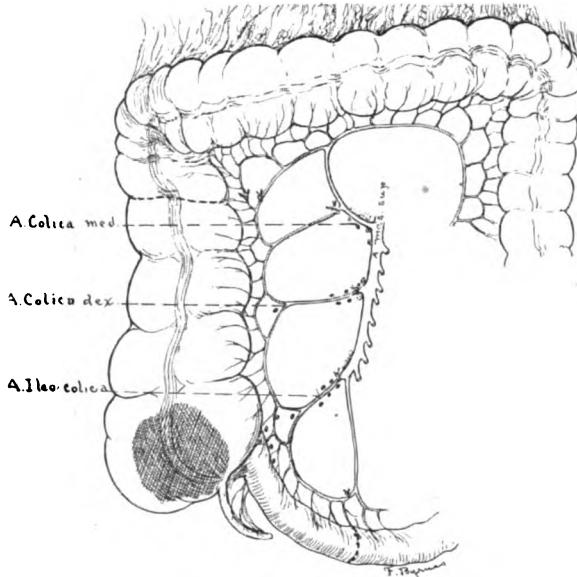


Fig. 86.—Carcinoma of cecum. The dotted lines show lines of resection.

found that a neighboring viscus has become involved and attached to it. If conditions are otherwise favorable, this should not be looked upon as a contraindication to operation. Five times in such cases we have resected portions of the small intestine, on two occasions resecting two entirely independent loops of the ileum, and, after completing the resection of the small intestine, removed the diseased colon with fragments of small intestine attached.

In our experience it has made very little difference by what method the anastomosis after resection was accomplished, so long as the

opening was large enough. Granting that end-to-end intestinal union is ideal, the results of the lateral or end-to-side have been functionally just as satisfactory. We have usually made a lateral ileocolostomy by suture, leaving beyond the opening as small an intestinal pouch as possible. It seems to be quite immaterial whether it is made isoperistaltically or antiperistaltically, whichever way the intestine will come together without angulation or traction. Ileocolostomy is a safe operation compared to resection of the colon in continuity, because the contents of the ileum are fluid as contrasted with the solid or semisolid character of the material in the colon (Fig. 86).

To recapitulate: The steps in resection of the cecum and ascend-

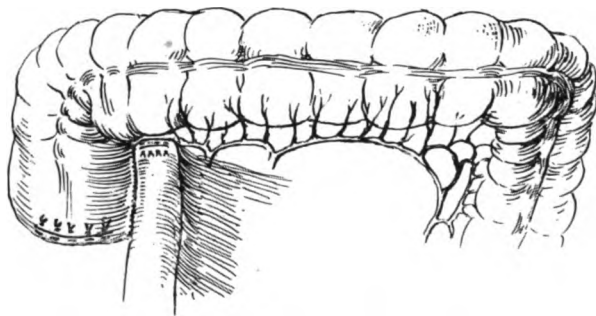


Fig. 87.—Lateral anastomosis following excision of the cecum and ascending colon, between the lower ileum and the hepatic flexure.

ing colon are: (1) A free incision through the right rectus muscle; (2) liberation of the cecum and ascending colon by an incision through the outer peritoneal attachment; (3) wiping clean, with a piece of gauze, the intestine and fat to the muscles as far as the superior mesenteric origin of the ileocolic and right colic vessels, which are tied at once, permitting an accurate dissection of the mesenteric glands and fat; (4) clamping the hepatic flexure and lower ileum at proper points and removing the diseased segment; (5) sterilizing the exposed mucosa with actual cautery after ligation of the ends of the cut intestine; (6) closing with purse-string sutures the bowel stumps; (7) ileocolostomy, usually lateral anastomosis; (8) closure of the mesenteric rent and the covering of the denuded surfaces with peritoneum (Fig. 87).

The type of the disease is usually adenocarcinoma, and the ileo-colic glands are nearly always affected. In some specimens the disease appears to have its origin in the appendix. In our cases, however, the appendix was generally so thoroughly involved as to make it impossible to arrive at any accurate conclusion on that point.

Sarcoma of the cecum is seen occasionally. We have resected for this condition twice.

RESECTION FOR CANCER OF THE CECUM.

Number of cases.....	27
Male.....	19
Female.....	8
Age of oldest.....	72
Age of youngest.....	31
Average age.....	48
Patients of ages between 30 and 40 years.....	7
Patients of ages between 40 and 50 years.....	12
Patients of ages between 50 and 60 years.....	3
Patients of ages between 60 and 70 years.....	4
Patients of ages between 70 and 80 years.....	1
Average duration of symptoms, 13 months.	
Operative mortality..... (11 per cent.)	3
Patients dying within 1 year after operation.....	1
Patients dying between 1 and 2 years after operation.....	3
Patients alive less than 1 year after operation.....	5
Patients alive 1 to 2 years after operation.....	3
Patients alive 2 to 3 years after operation.....	3
Patients alive 3 to 4 years after operation.....	2
Patients alive 4 to 5 years after operation.....	2
Patients alive 5 to 6 years after operation.....	1
Patients alive 6 to 7 years after operation.....	1
Patients alive 7 to 8 years after operation.....	1
Number not located.....	3
Total.....	27

RESECTION FOR THE RELIEF OF INTESTINAL OBSTRUCTION *

By WILLIAM J. MAYO

The frequent necessity of resection for the relief of intestinal obstruction is a somber commentary on the diagnostic ability of the profession. In the very large majority of cases delay in surgical interference is responsible rather than the primary cause of the ileus. The favorable cases are those in which there is interruption to the fecal current without vascular strangulation. The need for resection, however, usually arises from the damage to the blood-supply rather than from blocking of the intestinal lumen.

The important considerations are, first, the extent of vascular involvement; second, the degree of infection; third, amount and toxicity of the obstructed intestinal contents. The upper intestinal tract is comparatively free from pathogenic bacteria. Their number and virulence gradually increase toward the ileocecal orifice, and, as demonstrated by Herter, the terminal two feet of the ileum teem with these organisms. The walls of the empty intestine are comparatively thick and wonderfully supplied with blood, and in this condition, as shown by Dudgeon and Sargent, are entirely competent to prevent penetration of microorganisms, but if the fecal current is obstructed, the distention seriously impairs the blood-supply, the contents rapidly become infected, and the intestinal walls may no longer be able to prevent the egress of bacteria, and some of them will escape from the excessively distended part into the peritoneal cavity, where the circulation is

* Read in the Section on Surgery and Anatomy of the American Medical Association at the fifty-eighth annual session, held at Atlantic City, June, 1907. (Reprinted from "The Journal of the American Medical Association," September 14, 1907, vol. xlix, pp. 903-905.)

grossly impeded. For a time these invading microörganisms are picked up by the omentum (according to Mr. Bond), but general septic peritonitis soon supervenes, and the intestine above the obstruction becomes filled with fluids which are not only most infectious, but contain poisonous chemical products. Regurgitation of this material into the stomach requires careful emptying by gastric lavage before operation, for the reason that the regurgitated intestinal contents not only depress the patient, but the toxins may cause acute gastric dilatation. McArthur and Andrews have particularly called attention to the possibility of fecal drowning during operation, through the vomiting up of large quantities of fluids into the esophagus and aspiration into the lungs.

Treves says that the mortality in resections for intestinal obstruction was decreased one-half after it became customary to evacuate the intestinal contents through an incision, instead of allowing it to pass down into the healthy distal intestine, where it was absorbed. Evacuation is best accomplished after the method described by Monks. Through a small intestinal incision he introduces a long drainage-tube or blunt ovariectomy trocar into the lumen, slipping coil after coil over it as it is emptied.

Vascular changes in the intestine above the obstruction are greatly increased by the distention and local toxic effect of the contained liquids. For this reason it is necessary to go well above the seat of the disease to secure healthy intestine. A considerable percentage of the deaths following resection are due to perforation from thrombosis, and the utmost care should be taken in handling the distended intestine not to increase the vascular damage.

In searching for the seat of obstruction it is wise to go down to the ileum at the cecal termination and endeavor to find the collapsed intestine and trace this to the point of disease, rather than handle the distended gut. If the abdominal incision is badly placed, so that one cannot reach the seat of obstruction without tension on the mesentery, it is better to make a second more advantageous working incision. This is particularly true of strangulated femoral hernia. Here it is advisable to open the abdomen above Poupart's ligament, reduce the gangrenous loop into the abdominal cavity, and bring it

out of the upper incision so that resection may be easily accomplished.

Resection of the Small Intestine.—Lateral anastomosis with end closure by the two-row suture method we believe to be the safe resection for *acute* obstruction of the small intestine. It keeps away from the dangerous mesenteric border with its contained blood-vessels, and makes the anastomosis at a point where there is adequate peritoneum and the tissues are healthy. The fact that the contents of the small intestine are in a fluid state adds much to the safety. The intestine can be quickly crushed with heavy clamps and tied in the groove with catgut and the ends inverted like the stump in appendectomy and closed with a linen purse-string suture. More of the bowel should be removed opposite the mesentery, so that there will be no question as to the vitality of the part retained. The intestine should be held by clamps and the anastomotic opening made at least 3 inches in length, a point insisted on by Robert Abbe in his original work on "Lateral Intestinal Anastomosis."

While it is theoretically better practice to anastomose so that the intestinal peristalsis shall be continuous, clinically it seems to make little difference. The possibility of intussusception of the proximal blind end should be avoided by having it short and suturing the stump to the wall of the opposite intestines.

After resection for chronic obstruction of the small intestine end-to-end union is the operation of choice. I prefer the two-row method of suturing. The Connell single row of sutures and the Murphy button, in such cases, give equally good results. If the button is used, it must be made certain that there is no narrowing of the lumen of the intestine below which would prevent its passing out; and the line of anastomosis should be protected by four interrupted mattress sutures of linen or silk, so applied that they will pass the button.

The immediate functional results after end-to-end union are better than after the lateral. Cannon has shown experimentally that there is delay of food at the opening in lateral anastomosis and that this is not true of end-to-end unions. In time, however, the

lateral union adapts itself to circumstances, so that the fecal current is direct, and a slight elbow in the intestine is all that marks the site of the juncture.

Resection of the Ileocecal Coil, Ascending Colon, and Hepatic Flexure.—The ileocecal region is a favorable situation for operative interference. The blood-vessels are terminal, and it is not necessary to exercise the same amount of care as in the ligation of the mesenteric vessels higher up, where the main blood-supply is continuous to the intestine below. The contents of the ileum are in a fluid state, so that the mechanical conditions are much simpler than in the large intestine, where solid fecal masses endanger the integrity of the suture line.

The lymphatic arrangement of the large intestine is favorable for resection. The lymph-nodes are sparse and do not easily take offense, as would be expected from the nature of the colonic function.

Butlin's statistics show that more than half of the patients with carcinoma of the colon die from obstruction of the bowels before glandular metastasis has taken place. As a rule, ileocecal resection should include the ascending colon, and resection of the ascending colon should include the cecum. The certainty of union in ileocolostomy is so great, as contrasted with anastomosis in the colon, that the extensive removal of the intestine is more than compensated.

Ileocolic anastomosis should be lateral, and made between the lower ileum and the transverse colon near the hepatic flexure underneath the omentum. The intestine should be crushed and tied with catgut, after which the stump should be inverted with purse-string sutures; the two-row method of suturing with the aid of holding clamps gives the best results. We have, however, a number of times used the Murphy button, passing each half in through the open cut ends of the bowel and drawing the barrel out through a button-hole, making the juncture without the usual purse-string suture, as recommended by Robert Weir. The button union, however, should be protected by four or five mattress sutures of linen or silk.

In irreducible ileocecal or other intussusceptions the procedure of Mikulicz and Jessett, which is a modification of the Maunsell method, may be employed. After reducing as much of the intussusception as possible, an incision is made through the containing wall of the investing colon and the entire gangrenous mass lifted out, amputated, and sutured from the mucous side. After the stump is returned, a few sutures of linen or silk protect the serous surface. The working incision in the colon is separately closed.

Resection of the Transverse Colon.—In resecting part of the transverse colon it should not be forgotten that in four cases out of five the middle colic artery is the sole blood-supply, and unless these vessels are involved, they should be preserved, else the whole transverse colon will become devitalized. End-to-end or lateral anastomosis may be performed, as the parts are amply surrounded by peritoneum and invested in the folds of the omentum, so that the certainty of union is very good. The contents of the transverse colon are semifluid, which is favorable. The suture method, however, should be adopted, preferably the two-row with the holding clamps. The Murphy button should be avoided, as there may be fecal masses of sufficient size to obstruct the button lumen.

Resection of the Splenic Flexure, Descending Colon, and Sigmoid.—The colonic fecal container begins at the splenic flexure of the colon and extends to the upper border of the rectum. The splenic flexure and the upper part of the descending colon under normal conditions are empty, acting rather as a connecting link or passageway to the sigmoid, which is the true fecal reservoir. That portion of the sigmoid which is closely attached to the iliac fossa the English call the iliac colon, and the part lying between this and the rectum, the pelvic colon, which is more accurately descriptive than the term sigmoid.

Resection for obstruction between the splenic flexure and the rectum should usually be made in two stages on account of the solid character of the feces. The cause of the obstruction is most frequently new-growths or extensive inflammatory disease, such as diverticulitis. Immediate end-to-end or lateral union may be

advisable when there is no obstruction, especially in that part completely invested with peritoneum, but if there is obstruction, the complete primary operation is often fatal. It is far better to follow the method of Mikulicz and Paul, which consists in drawing the affected part out of the abdomen, and after separating its mesentery and suturing the two limbs together, attaching it to the abdominal incision, with the diseased part projecting beyond the skin. After waiting as long as the condition of the patient will permit for adhesions to protect the wound, the obstruction is relieved by a small opening in the distended loop. In from two to four days the entire projecting area is cut away, leaving the two ends of the colon flush with the skin, side by side like a double-barreled gun. At the end of two weeks a pair of clamps is introduced, one blade in each opening, and made to grasp the opposed walls of the intestine, where they are held by the sutures for a distance of not less than $3\frac{1}{2}$ inches. The clamps are gradually tightened until they cut their way through, which takes from four to six days. This reestablishes the communication. The fistula gradually contracts, and will either close itself, or can readily be closed by secondary plastic operation.

After-treatment of Intestinal Resection.—The care of patients following intestinal resection is important. First, the patient should have the head and chest raised to the semi-sitting posture for several days after the operation, so that the sepsis may be gravitated away from the sensitive diaphragm to the pelvis, where it will be more safely absorbed. Second, in obstruction of the small intestine especially, per rectum salines are almost a necessity, four or six quarts in the adult during the first twenty-four hours, as recommended by Murphy, to aid elimination and relieve the dehydration so frequently present. Third, the stomach must be carefully and repeatedly emptied and irrigated with hot water if there is any tendency to prolonged nausea or vomiting.

CONGENITAL IDIOPATHIC DILATATION OF THE COLON: "HIRSCHSPRUNG'S DISEASE" *

By E. S. JUDD

As early as the years 1820 and 1825, Billard and Parry, respectively, described instances of enormously dilated colons without apparent obstruction anywhere in the alimentary tract; but it was not until 1886 that Hirschsprung made his first report of the condition which in this country has been termed "*giant colon*."

The most marked feature of the disease is the great dilatation of the whole of the colon, and its peculiar characteristic, that no mechanical or specific cause for the condition can be found. According to a report of Finney,† Mr. Harold Stiles reports five operated cases, and advances nine different causes for the trouble. Finney has given a most thorough review of the subject and suggests lymphangiectasis as the chief etiologic factor, because it appeared to him that the most striking feature in the case he had under observation, aside from the dilatation of the colon, was the enlargement of the lymph-glands and the dilatation of the lymph- and blood-vessels in the mesocolon.

Besides the condition lymphangiectasis the other causes suggested are an abnormally long mesocolon, chronic colitis, increased length of the colon, mechanical obstruction, congenital aplasia of the muscular tunics of the intestine, spastic contraction of the sphincter and anal fissures, neuromuscular defect, and valve-formation.

In all reported cases the dilatation is associated with a marked

* Read at the fortieth annual meeting of the Minnesota State Medical Association, held at St. Paul, October 6 and 7, 1908, and reprinted from "The Journal-Lancet," January 1, 1909.

† "Surgery, Gynecology, and Obstetrics," July, 1908.

hypertrophy of each layer of the intestinal wall, and although there has been considerable discussion as to whether the dilatation or hypertrophy is primary, the majority of observers are agreed that the factors are the same as in other regions under similar circumstances, and that the hypertrophy is secondary and an effort to compensate for the dilatation.

Clinically, the disease will be easily recognized if the patient is seen while the colon is distended, though if he is examined just after the bowels have been evacuated, the condition might be mistaken for a simple obstinate chronic constipation.

The principal complaint made by patients is their inability to move the bowels without the use of an enema and general bowel distention. This forced distention is most marked in the left side of the pelvis in the region of the sigmoid, continuing upward to the splenic flexure and across to the right hypochondrium region, gradually fading away in the right side of the pelvis. The early histories show that these symptoms existed a few days after birth, and often, as in the case I will report, the mother had never been able to get the child's bowels to move without the use of an enema. It is characteristic of these cases that they will go for a month or six weeks, and even for three months, without having a passage from the bowels; then for a day or two there will be many large movements of very foul feces, to be followed again by weeks of constipation.

In many cases the deformity extends to the chest because of the pronounced abdominal distention. This condition was not marked in the case I am reporting. Palpation and percussion of the abdomen reveal the intestine distended with gas and feces. The patient we refer to never had pain, except when there was unusual distention, and he had vomited but once, when there was complete obstruction to all feces and gas for four days. As a rule, there is no pain or vomiting. Rectal examination with the finger or the proctoscope usually reveals nothing abnormal except, possibly, ballooning of the rectal walls.

In practically all cases the large bowel, and especially the sigmoid, is the part involved, but at times the small bowel, stomach,

and esophagus are involved in the dilatation. The dilatation be-

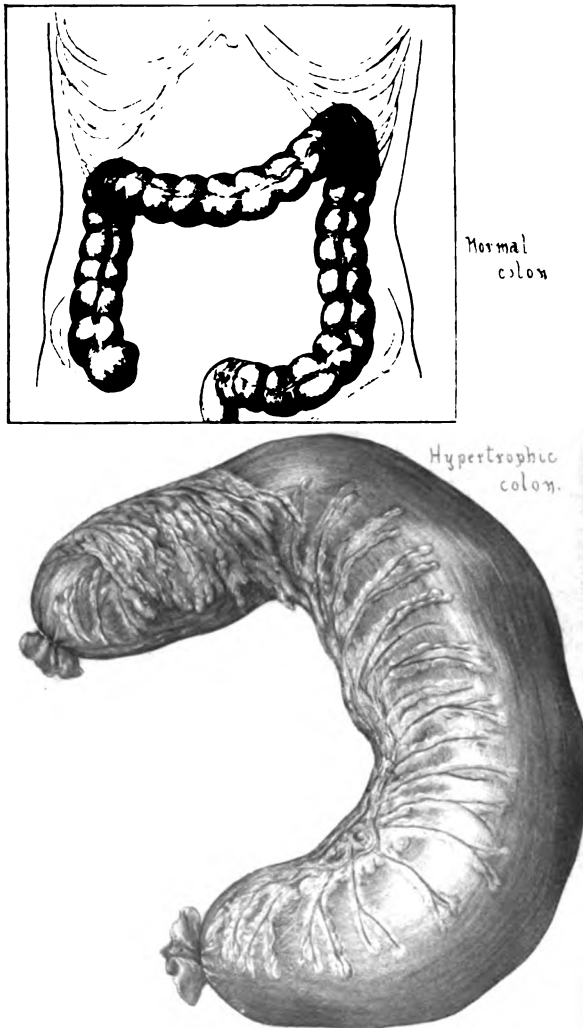


Fig. 88.—Hypertrophic colon removed in the case of Mr. ——. Dimensions: 27 inches long, 6 to 9 inches in diameter. The normal colon, drawn above, is to show the comparative size.

gins gradually and reaches its maximum within a few inches.

The termination is abrupt, usually just at the beginning of the rectum. There is no evidence of mechanical obstruction. The bowel contains large quantities of gas and thin feces. The mu-

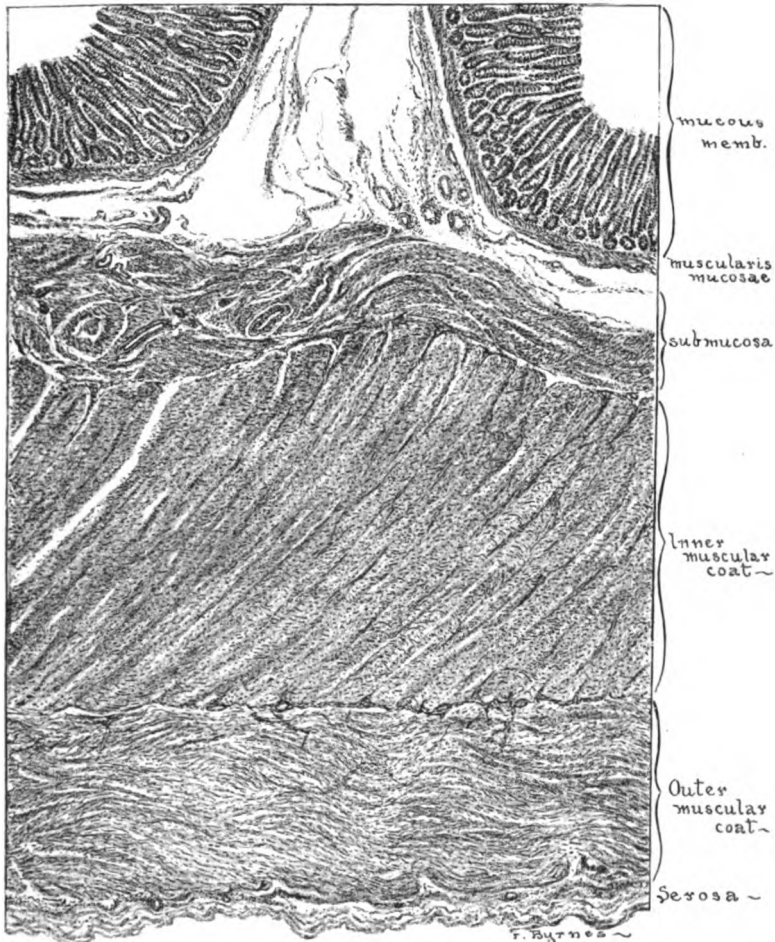


Fig. 89.—Section through wall of hypertrophied colon, magnified 12 diameters.

cosa may show marked pigmentation and ulceration. The intestinal wall is greatly hypertrophied, and the mesocolon thickened, although this latter condition was not especially noticeable in the

present case. Microscopically, the wall of the intestine was a little less than twice its normal thickness, an increase due more to the hypertrophied muscle than to the mucosa. The muscularis mucosæ was greatly hypertrophied, especially its circular fibers; the submucosa was not greatly changed. The circular and longitudinal muscle-coats were very greatly thickened (more than twice their normal thickness) due entirely to a hypertrophy of the normal muscle-fibers.

The specimen showed an unusual lack of pigmentation in the mucosa which Dr. Finney describes in his cases. There were no signs of necrosis or ulceration; on the contrary, all coats except the mucosa were simply hypertrophied. The natural folding of the mucosa was completely gone, the surface being perfectly smooth and glossy. Microscopically, this coat showed a regular and symmetric arrangement of the glands, which were about normal in length. In the interglandular stroma were a few leukocytes and a very small amount of brown pigment. From a pathologic as well as a clinical standpoint the lack of extensive inflammatory changes is marked. This disease is more common in boys than in girls, and it may exist for years, though some of the reported cases have lived but a few weeks.

The patient in question is a boy sixteen years of age, born in South Dakota, of German and Scotch descent. Family history of no particular importance. The boy had chicken-pox, measles, and whooping-cough, but had been otherwise well, except for the trouble with his bowels. Soon after his birth it was discovered that nothing would pass his bowels without the aid of an enema. This condition remained for years, the patient taking large doses of laxatives of all descriptions without their having any effect. They caused no griping or discomfort of any kind. Between the ages of ten and eleven, laxatives and enemas were discontinued, and during this time one and two months would elapse without his having a passage from the bowels, then for a day they would move almost continuously, there having been as many as eighteen movements in twelve hours. At the end of his eleventh year there was a period of complete obstruction, when for four days not even gas was passed. Oil ene-

mas finally started the gas, and after that he took an enema every day, keeping fairly comfortable on the days when the enema was successfully used. The boy is well developed and strong now, although this development did not begin until during his eleventh year, when he commenced the use of the enema each day. The chest examination was negative except for some spreading of the ribs and evidence of the diaphragm having been crowded up. The abdomen was found distended, especially in the left side of the pelvis. The colon could be easily outlined. Liver dullness was slightly diminished. There were peristaltic waves every few minutes. Rectal examination, negative.

The patient was operated upon July 22, 1908, in St. Mary's Hospital, by Dr. W. J. Mayo. The greatly dilated colon almost filled the entire abdomen, the dilatation beginning at the hepatic flexure, increasing in size to the middle of the transverse and descending colon, reaching the point of maximum dilatation at the sigmoid, and terminating abruptly just at the beginning of the rectum. The distended part of the colon was at least eight inches in diameter, and the large portion on view, with its tense, whitish covering and distended blood-vessels, looked not unlike an ovarian cyst. The mesentery was not greatly thickened. The bowel contained large quantities of gas and thin feces.

Operation.—Resection beginning at the hepatic flexure and extending to the rectum. The ends of the colon were turned in by purse-string linen sutures, and a lateral suture anastomosis was made between the ascending colon and the anterior surface of the rectum. The section removed was 27 inches long and 6 inches in diameter *without forcible distention*. The wound was closed without drainage. On the third night after the operation the patient's bowels moved without the aid of a laxative or enema, and they have continued to move from one to four times each day since without using artificial means. He left the hospital August 4th and was discharged from our care August 22d, well. That this condition has continued to date has been confirmed by correspondence. He writes that he is eating well and feels all right.

VALUE OF SONDERN'S DIFFERENTIAL LEUKOCYTE RESISTANCE-LINE IN THE DIAGNOSIS AND PROGNOSIS OF ACUTE APPENDICITIS *

By L. B. WILSON

In the early days of leukocyte counting many hailed the method as giving most valuable information concerning the condition of the patient's resistance in acute appendicitis. It was soon found, however, that the problem was not nearly so simple as, on the face, it appeared, the mere increase of leukocytes being present in a variety of conditions. When differential counts began to be made, the interpretation of the results became even more difficult—so much so that many observers were inclined to throw aside the whole method as furnishing only unreliable data.

We owe to Prof. Frederick E. Sondern,¹ of New York, a suggestion which, it seems, may clear up some of the troubles in the determination of the patient's resistance in acute appendicitis by means of the differential leukocyte count.

Acting on Sondern's hypothesis, Dr. C. L. Gibson² compiled the results in about 200 cases in which the blood-examinations were made by Prof. F. C. Wood, of the Pathologic Laboratory, St. Luke's Hospital, New York.

While our data were being analyzed, Dr. Noehren,³ an interne at the German Hospital, New York, published data from 52 cases of acute appendicitis, in which both a leukocyte count and an estimate of the polynuclear percentage were made.

As a means of recording observations and facilitating a com-

* Author's abstract of paper read before the Hennepin County Medical Society, March 2, 1908. (Reprinted from "The Journal of the Minnesota State Medical Association and The Northwestern Lancet," July 1, 1908.)

parison of the work of the different observers, Gibson² suggested the use of a standard chart (Fig. 90). This chart is divided into

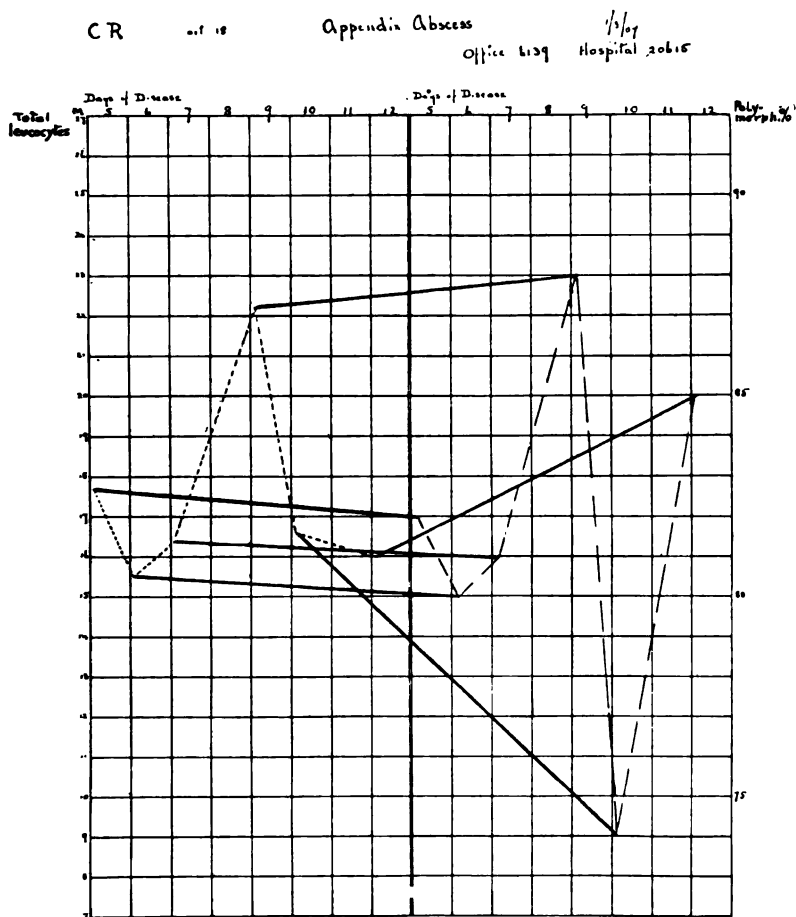


Fig. 90.—Case recorded on Gibson's chart.

units of 1 sq. cm. and arranged according to the following data: The starting-point of pathologic leukocytosis is assumed to be 10,000; that is, that the highest variant of the normal leukocyte

count does not run above this figure. The starting-point of the normal polynuclear percentage is assumed to be 75 per cent.; that is, in conditions of health the normal polynuclear percentage does not run above this figure. The count of 50,000 total leukocytes is assumed to be the normal minimum limit, while 70 per cent. is assumed to be the normal minimum limit of polynuclears. If, now, the total number of leukocytes is recorded on the left side of the page, and the percentage of polynuclears is recorded on the right side of the page, and the normal maximum and minimum of the two be placed on their relative horizontal lines, *i. e.*, 5000 leukocytes on the same line as 70 per cent. polynuclears, and 10,000 on the same line as 75 per cent. polynuclears, with the horizontal interspaces equally subdivided and higher percentages and thousands added thereto, it will be found that a chart is formed that is very convenient for single observations.

When we began our observations two years ago, we recorded on this standard chart. We very soon found, however, that, while the horizontal arrangement seemed to be correct, the vertical subdivision of the entire page made an extremely complicated diagram when a curve was struck on several observations on the same patient. Now, while it is true that usually only the first observation is of any particular value from the clinical standpoint, it occasionally happens that numerous observations should be recorded either for clinical controls or in order to determine the value of the method itself. I have, therefore, modified Gibson's chart as shown in Fig. 91 *et seq.* It will be seen here that a double vertical column is used for each day's observations. The left subdivision of the column records the total leukocytes, and the right subdivision records the percentage of polynuclears. The chart thus becomes essentially a series of Gibson charts placed side by side in a small compass on the same page. It also accentuates the slope of the line connecting total leukocytes with polynuclear percentage. Thus, the resistance-line is a heavy unbroken one; the leukocyte curve is indicated by a fine dotted line, and the polymorph by a slender broken line. The difference in the complete record of a case on the two charts is well shown by Figs. 90 and 91.

To assist in the interpretation of the resistance-curve on the chart, we may compare it roughly to the temperature-curve. Thus,

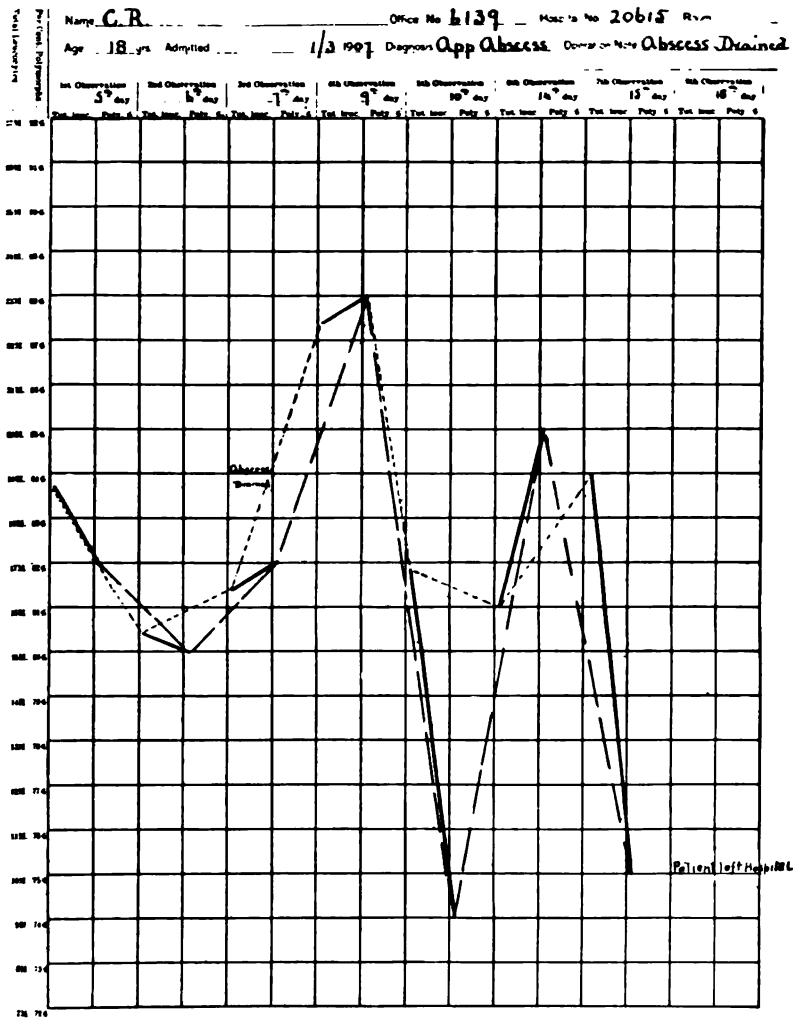


Fig. 91.—Same case as Fig. 90, recorded on author's chart. Fifth day case with well-walled abscess.

wherever the line lies high and is going up, the patient's resistance is bad; when it is low and going down, the resistance is good.

great haste has been necessary, two men have worked simultaneously on the case, one making the total white count and the other

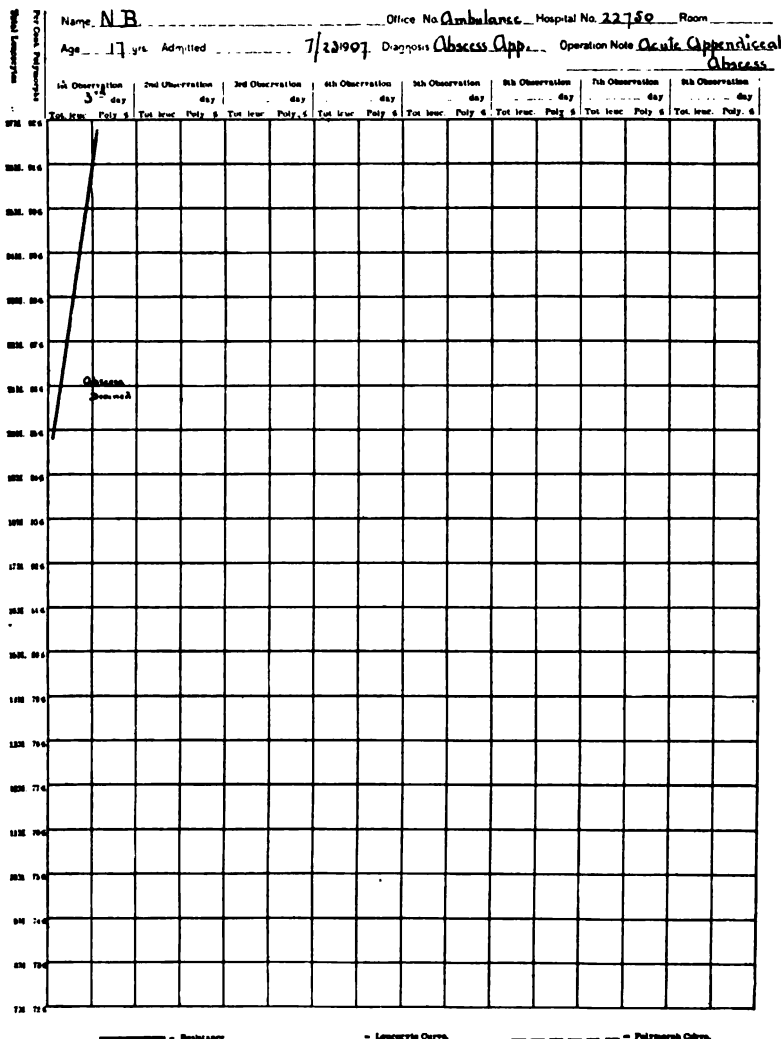


Fig. 93.—Early purulent appendicitis without walled-off abscess.

the differential count. We have not, however, found Deaver's⁶ objection to the method, on account of the immense amount of

time necessary to make the counts, a valid one. An experienced man working in his own laboratory, and with the patient readily accessible, can make a very reliable count in twenty minutes. This time may be halved by two men working simultaneously on the preparations.

We have grouped our cases roughly into (A) those which come under observation on or before the third day, and (B) those which come under observation on or after the fourth day.

In group "A" we have (1) cases of acute catarrhal appendicitis; (2) cases of early purulent appendicitis without walled-off abscesses; and (3) cases of chronic appendicitis without pathologic evidence of the real or imagined acute exacerbation.

Class A-1 is illustrated by chart (Fig. 92*):

Case 22,751 is a twenty-four-hour case, a simple catarrhal appendicitis in a woman thirty-one years of age in apparently good condition. She had 15,000 total leukocytes with 81 per cent. polynuclears. Her resistance-line on the standard chart thus rises toward the right, indicating a slight disproportionate increase of the polynuclears.

All of these cases were ambulance cases and were more or less affected by the railway journey. In all of them a disproportionate increase of polynuclears over total leukocytes was parallel with the clinical condition and the pathologic findings. While these cases are selected ones from a group, the others show exactly the same parallelism of blood-findings with clinical conditions.

Class A-2 is represented by the following case (Fig. 93†):

Case 22,750 is a sixty-hour purulent appendix in a girl seventeen years of age. Here the total leukocyte count was 20,000, with 28 per cent. polynuclears. Operation disclosed a large abscess very imperfectly walled off.

The third group of early cases (Class A-3) is represented by the following (Fig. 94):

* Four cases of this type given in the paper as read.

† Four cases of this type given in the paper as read.

Case 23,211 is a woman, thirty-five years of age, who passed through several attacks of appendicitis and was brought into the

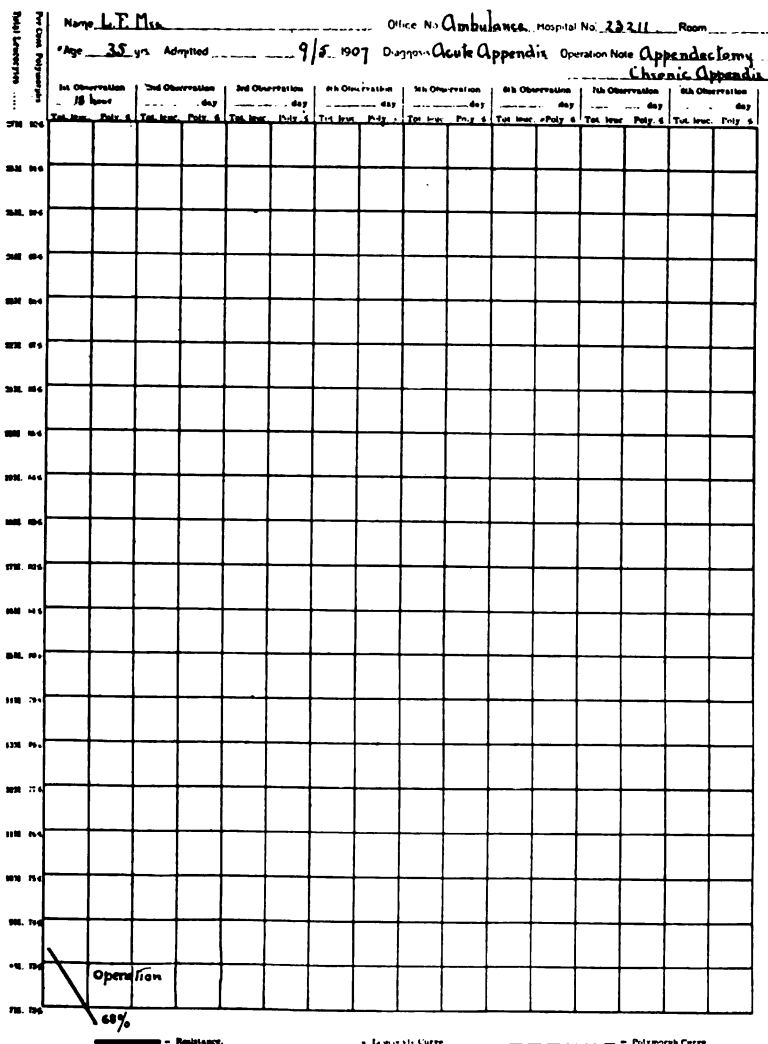


Fig. 94.—Supposed acute appendicitis occurring in the course of chronic appendicitis. At operation only chronic lesions were found.

hospital eighteen hours after the supposed onset of the acute attack. The total leukocytes were 83,000, and her polynuclear percentage

68. Her appendix, when removed, showed the result of chronic inflammation in its adhesions, etc., but no acute inflammation whatever. These two cases,* though representing but a small group from our list, are here inserted as showing the possible value of the differential leukocyte count even considered negatively.

The second large group, Class B, *i. e.*, fourth-day or later cases, may be subdivided into (1) cases in which a well-marked-off abscess exists; (2) cases in which there is an imperfectly walled abscess; and (3) cases in which there is a very small and disappearing abscess.

It is this group of cases, that is, between the fourth and twelfth days, in which we need all possible data concerning each individual case in deciding whether or not immediate operation is necessary.

Case 20,615 (Fig. 91) is a fifth-day case in a boy eighteen years old. His total leukocytes were a trifle under 19,000, and his polynuclear percentage 82 when he entered the hospital. The following day his clinical condition was somewhat improved, and his differential count showed a corresponding reduction. On his third day, however, his clinical condition seemed worse, and his differential count a correspondingly rising resistance-line. He was, therefore, operated on, and a large abscess drained. Two days later, as nearly always happens when a case is operated on when a rising resistance-line is present, his differential count had very materially risen, showing a total leukocyte count of 22,500, and a polynuclear percentage of 88. This on the following day was materially reduced, and he went on to an uneventful recovery.

We pass now to cases of a later period with well-walled-off though large abscesses.

Case 18,393 (Fig. 95) is a twelfth-day case of this type in a man thirty-three years of age. Just before the operation the total leukocytosis was 12,500, and the polynuclear percentage 76. Six hours after the operation the leukocytes arose to nearly 22,000 and the polynuclear percentage to 89, showing the effort of the leukocytes to meet the increased absorption toxemia. The following day, however, showed markedly disproportionate decrease in the polynuclear percentage.

* Two cases of this type given in paper as read.

Coming now to Class B-2, that is, later cases in which there is more or less clinical evidence of peritonitis, let me present two cases.*

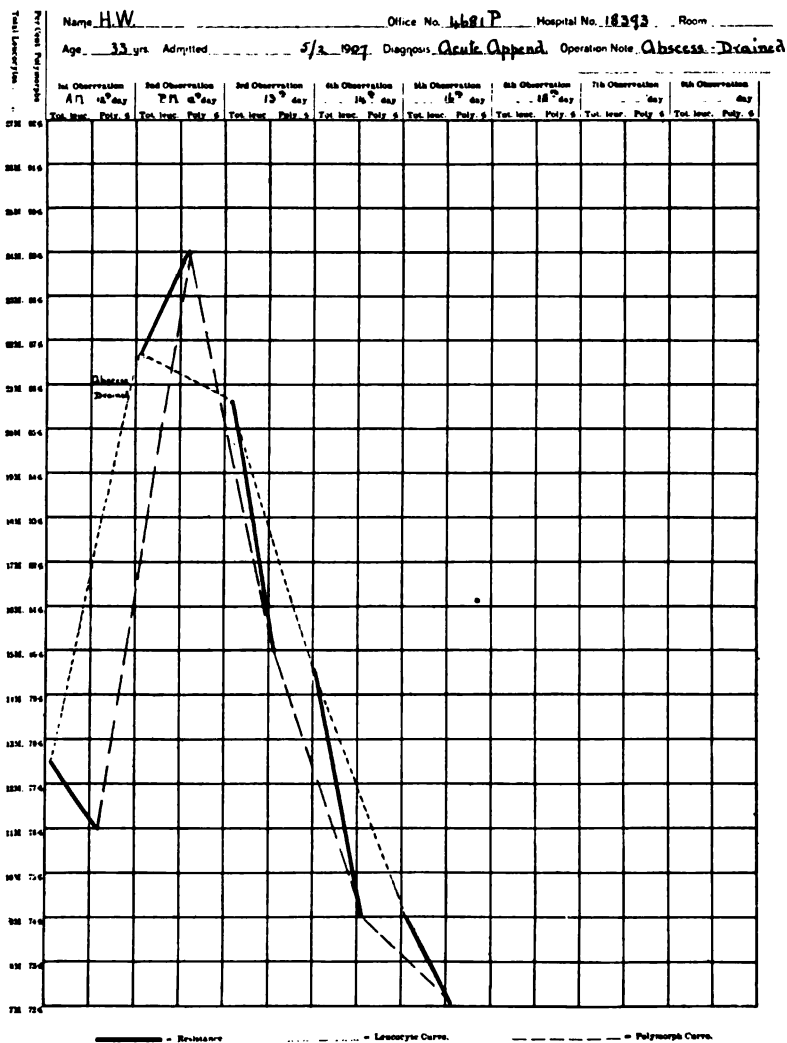


Fig. 95.—Twelfth-day case. Well-walled abscess.

Case 22,383 (Fig. 96) is a man, twenty-five years of age, in the tenth day of his attack. While his total leukocytosis is only 22,000

*Two cases in paper as read.

his polynuclear percentage is 96, a very bad resistance-line.

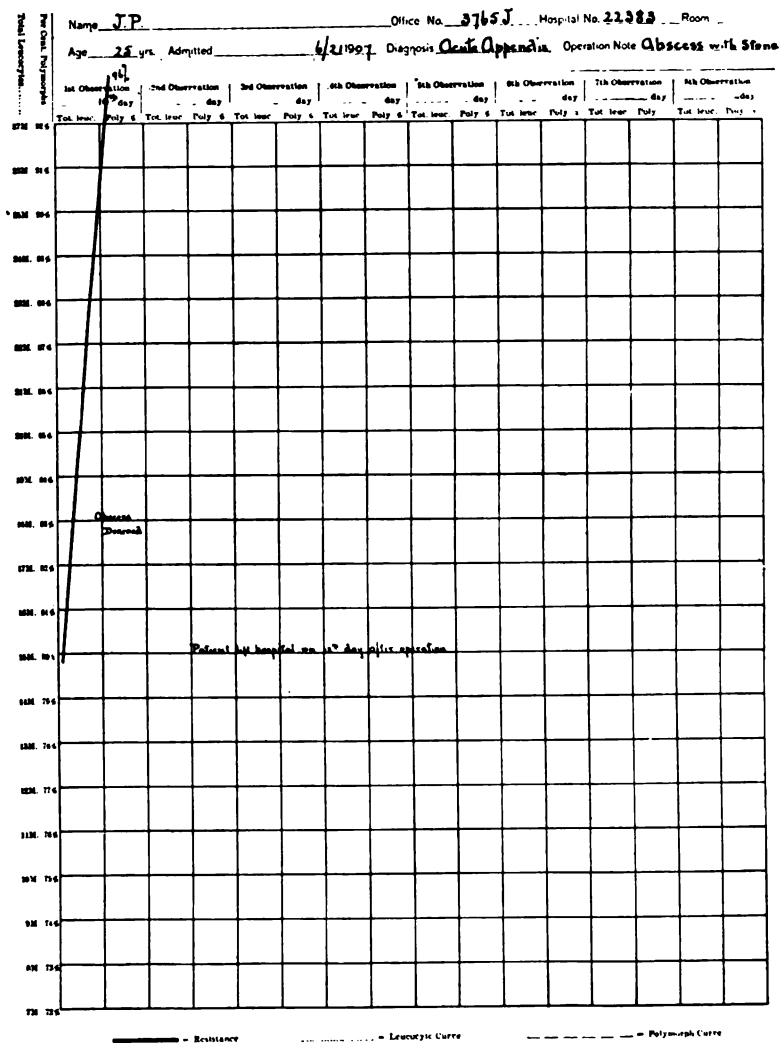


Fig. 96.—Tenth day. Badly walled abscess.

Clinically, the man seems profoundly toxic though not moribund. Operation shows badly walled abscess.

Group B-3, consisting of late cases with small-walled abscesses, will be illustrated by the following two cases:*

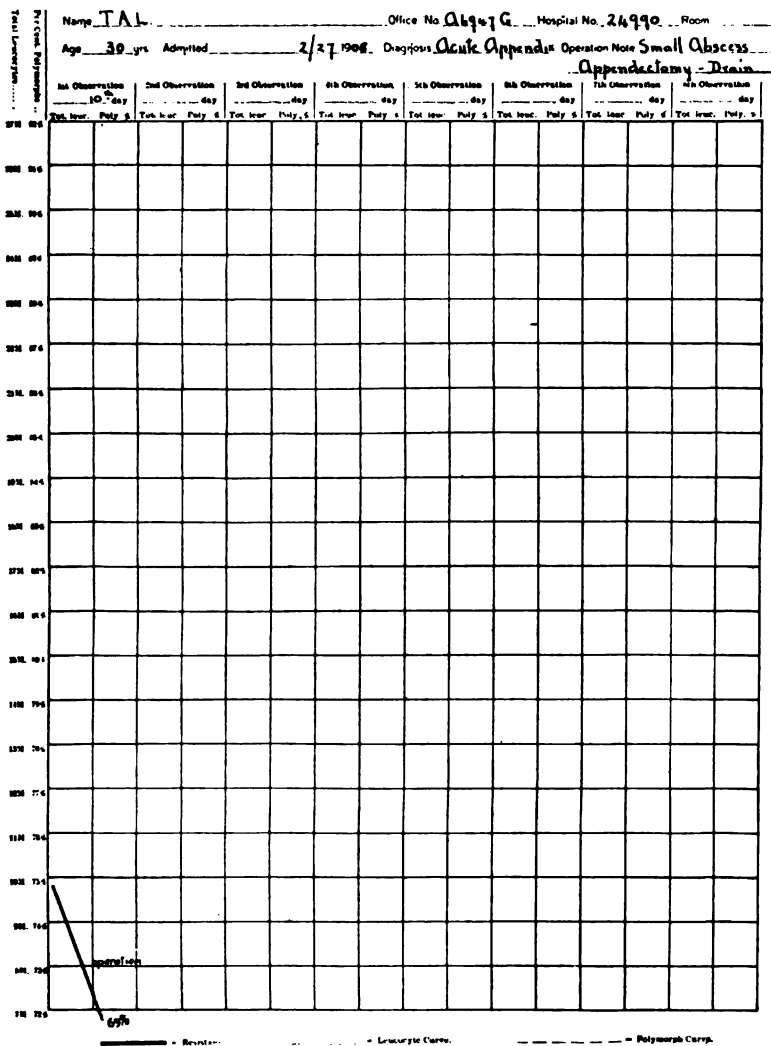


Fig. 97.—Tenth-day case. Very small, well-walled abscess.

Case 24,990 (Fig. 97) is a tenth-day case in a male thirty years of

* Two cases in paper as read.

age. He had 10,000 leukocytes, 60 per cent. of which were polynuclears. Operation revealed a small, well-walled abscess.

Summary.—Though no sweeping conclusions would be warranted from the preceding data, nor, it seems to the writer, even from the sum total of all the cases that have hitherto been published, yet, so far as the cases go, the following statements may be made:

1. Sondern's hypothesis, that the polynuclear percentage is an index of infection, the total leukocytosis an index of body reaction, and their proportional relationship an index of resistance, seems to be supported. The more important exceptions to this are in moribund cases and perhaps in children.

2. As practically applied in early appendicitis cases the disproportional polynuclear increase, *i. e.*, a rising resistance-line, indicates a more or less severe infection, which is not being properly cared for by the body. The higher and longer this line, the more serious the case.

3. A proportional polynuclear percentage or a disproportionate polynuclear decrease, if well marked, indicates mild or well-cared-for infection.

4. The value to the surgeon in early cases is but little, since most early cases are operated on any way. It may be of some value negatively in indicating that the supposedly acute exacerbations of chronic appendicitis are not present.

5. In cases between the fourth and fourteenth days the resistance-line is of great value to the surgeon in indicating the patient's poor resistance and the necessity for immediate operation. The operative findings in these cases bear out the leukocyte determination with wonderful accuracy.

6. In cases like those in No. 5, a horizontal or falling resistance-line indicates that the patient is taking care of the infection. If the infection is severe, as shown by a high though falling line, the patient may perhaps best be given medical treatment rather than submitted to operation.

7. When such a case as is indicated in No. 6 is being kept under observation, the resistance-line should be determined daily; and should the line begin to rise, the patient may be submitted to operation.

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ACQUIRED DIVERTICULITIS OF THE LARGE INTESTINE *

BY WILLIAM J. MAYO, LOUIS B. WILSON, AND H. Z. GIFFIN

During the past eleven years a certain group of cases has been observed clinically, but they have not until recently been placed upon a sound pathologic basis. The cases of this description which have come to our notice are as follows:

In 1896 a well-nourished man of fifty-one years of age presented himself at our clinic with an internal fecal fistula into the bladder. The history in brief was that some months previously he had been seized with pain and soreness in the left inguinal region and a tumefaction followed. After a number of weeks of illness there was a spontaneous evacuation of a large amount of foul pus by way of the bladder. The tumor disappeared, but from that time there had been more or less escape of gas and feces into the cystic cavity. A diagnosis was made of probable appendiceal abscess with secondary internal fistula. Upon opening the abdomen the appendix was found normal, but in the sigmoid flexure of the colon was a considerable sized sausage-shaped tumor embedded in a mass of adhesions, and a fistula existed between the sigmoid and the bladder. This was divided, the opening into each viscus sutured, and free drainage introduced. The suturing proved imperfect, and a combined urinary and fecal fistula to the surface was the result. The bladder-opening healed in a few weeks, but when the patient was last seen, two years after the operation, the fistula occasionally discharged gas and hard particles of feces.

Second and third cases of the same character have since been under our care. The colon which has been concerned is that part

* Read before the American Surgical Association, May 8, 1907. (Reprinted from "Surgery, Gynecology, and Obstetrics," July, 1907, pages 8-15.)

which stores waste products for intermittent elimination, and lies distal to the splenic flexure.

In addition to these three cases of internal fistula, several patients have presented themselves with abscess or external fistula, having the same etiology. One, a physician, very fleshy, had been suddenly taken sick with what he described as "like an appendicitis on the left side." After a number of weeks a large abscess formed. This was evacuated by an abdominal incision. Since that time there has come to the surface of the body a small fecal fistula which would nearly heal and then be followed by an exacerbation, with the escape of a purulent fluid containing one or more small hardened fecal masses about half the size of a pea. Under the belief that it was in some way connected with the appendix, this organ had been removed by the surgeon in charge, and found to be normal, the seat of the disturbance being located in the sigmoid.

Another case was that of a male who had two years before been operated on for acute appendicitis, and who said that the present trouble was exactly like that of his attack of appendicitis, except that it was located on the left side.

In five instances patients have presented themselves with a well-marked tumor in the left side, which in three cases had appeared suddenly with inflammatory symptoms; obstruction of the large intestine had resulted. In all five the colon was resected, and in each the gross appearance *in situ* was that of carcinoma. Examination of the removed specimens, however, showed that no malignant disease was present.

But not all of these cases go on to the production of such serious symptoms. We have had a small number of elderly, and usually obese, patients who have been suddenly attacked with severe pain in the left side, with the appearance of an indefinite tumefaction. After a thorough evacuation of the bowels the trouble would subside, though the feeling of tenderness and resistance on deep palpation lasted for several weeks. In two of these individuals there have been one or more relapses.

All the patients coming under observation have had certain features in common. They were over forty-five years of age; all

but four were males, and, except for this illness, were otherwise in robust health, most of them inclining to obesity. The onset of symptoms was sudden and presented the characteristics of a localized peritonitis. A tumor rapidly developed, and usually lay to the left of the median line in the middle or lower quadrant of the abdomen.

In all of the cases the disease has originated in the descending colon and sigmoid, between the splenic flexure and the rectum, structures which are derived from the primitive "hindgut."

The cases briefly cited above naturally drop into three clinical groups: First, those in which an intraperitoneal abscess forms, with spontaneous evacuation into a neighboring viscus, or evacuation externally by means of operation; second, those cases giving rise to acute or chronic obstruction necessitating operation; third, those in which the symptoms are mild and recovery occurs spontaneously.

Surgical Treatment.—The surgical treatment of diverticulitis of the colon depends upon the condition present. First, localized suppurative cases must be treated by free drainage. If, in conjunction with the infective process, acute obstruction of the bowels develops, as in the cases reported, a temporary artificial anus should be made, and, if necessary, after the infection has subsided, the involved colon may be resected. Second, if a considerable tumor is present and the symptoms do not show a tendency to disappear, it is better to make a primary resection of the affected part of the bowel, before abscess and fistula supervene to render patients prolonged invalids.

In all of the cases which we have resected, the disease has been limited to from 4 to 8 inches of the gut, and all of those that recovered from the operation have remained in perfect health. The milder cases which tend to spontaneous recovery do not suggest operative treatment.

Dr. L. B. Wilson will discuss the pathology of these cases and Dr. H. Z. Giffin the clinical course.

REPORT ON THE PATHOLOGIC EXAMINATION OF FIVE CASES OF
DIVERTICULITIS AND PERIDIVERTICULITIS OF THE SIGMOID.

(By Dr. L. B. Wilson.)

CASE 1. (H1903.)—The specimen of sigmoid resected in this case was about 16 cm. long (Fig. 98).* The mesentery contained a hemispheric nodular mass, 1 to 4 cm. thick, and 7 cm. in transverse diameter. This mass consisted of two diverticula, swollen glands, and inflammatory exudate. On section, one of the diverticula (Fig. 99) was found to have ulcerated almost through into the peritoneum. Its walls had sloughed and presented ragged, overhanging edges, leading to a provisional diagnosis of carcinoma. Microscopic examination, however, showed no carcinoma.

The other diverticulum (Fig. 100) had an inflammatory mass 3 cm. in diameter surrounding its base, and protruding into the lumen of the bowel about 1 cm. This mass had almost closed the opening into the diverticulum. The diverticulum contained an irregularly shaped enterolith.

The walls of the diverticulum consisted of the following coats:

1. Mucosa, markedly atrophied around the proximal end of the lumen, where pressure had been greatest from the thickened gut walls, and fairly well preserved around the saccular portion.

2. Submucosa, a strong fibrous coat, thicker in the proximal than distal portion.

3. Muscularis, fibers derived from the circular coat of the sigmoid, and thickened by fibrous infiltration to twice the thickness of the same coat in the normal portion of the sigmoid. The muscularis in the sigmoid wall, where penetrated by the diverticulum, was much thicker.

4. A layer of fibrous tissue from the subserosa.

CASE 2. (16736.)—The portion of sigmoid removed was about 20 cm. long and 7 cm. thick. The lumen was so reduced that it was with difficulty that a glass rod 1 cm. in diameter could be passed through it. The specimen had the roughened external appearance and hard nodular feel of a carcinoma of the sigmoid. Sections showed the walls to consist, besides the thickened muscularis, of a fat-infiltrated, inflammatory mass, mostly in the subserosa, and containing multiple diverticula. On dissecting away the tissue from about the diverticula (Fig. 101), they were found to be small, thin-walled, and many of them containing in their sacculated

* The accompanying pictures (Figs. 98-105, 107) representing types of this condition are to be viewed through a stereoscope.

extremities hard, black enteroliths. Examination of the walls of ten of the diverticula showed no muscularis whatever. Their hernial nature was further shown by the fact that all had penetrated the haustra of the sigmoid well away from the teniæ of the longitudinal muscularis. Careful examination of the circular muscularis showed areas of marked thinning, even where no diverticula had developed. None of the diverticula gave evidence of marked inflammation within the lumen.

CASE 3. (18856.)—The portion of the sigmoid removed was about 15 cm. long and 5 to 8 cm. thick. The diameter of the lumen was much reduced. The wall showed the results of a chronic inflammatory process in its thickened submucosa, muscularis, and subserosa, the latter being infiltrated with fat. There was marked hyperplasia in all the glands removed. Immediately after the operation, a large portion of the inflammatory mass was divided into blocks for histologic examination, both in this laboratory and in the laboratory of the patient's home physician, so that the exact number of diverticula penetrating the sigmoid wall was not accurately determined. However, when the specimen was later dissected, two typical examples of small false diverticula were found (Fig. 102). One of these contained an enterolith. The other, though sacculated, contained none. There was no evidence of inflammation within the lumen of either. The walls of both were quite thin and devoid of muscularis. Besides these two fully developed diverticula, several pocketings of the mucosa were present. At each of these the circular muscular fibers were markedly fewer than in surrounding areas.

CASE 4. (19305.)—The resected portion of the sigmoid in this case was about 17 cm. long and 6 cm. thick. The thickening was due to chronic inflammation, principally in the muscularis and subserosa, into which had penetrated numerous diverticula (Fig. 103). The circular muscular coat contained many thinned areas, in some of which, indeed, the muscular fibers seemed to be entirely absent. In these there was always pocketing of the mucosa and submucosa with usually compensatory hypertrophy of the inner fibers of the subserosa.

All the diverticula were small, with more or less atrophied mucosa (Figs. 104 and 105, and Sketch 106), thickened submucosa, and no muscularis. Their distal ends were well surrounded with the markedly increased fibers of the inner portion of the subserosa. Many contained enteroliths. None showed inflammation within the lumen. None perforated into the bands of longitudinal muscle-

fibers. Recent infection with *B. tuberculosis* was demonstrated in the enlarged glands in the specimen, and later elsewhere in the peritoneum when the case came to autopsy.

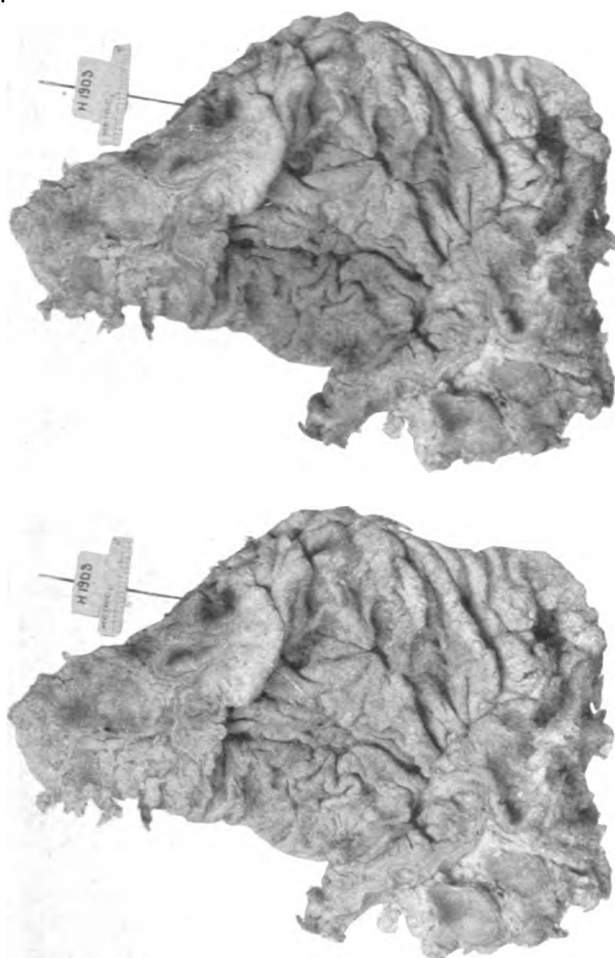


Fig. 95.—Diverticulitis. Case 1. (H 1903.) $\times 3$ diam. Sigmoid laid open longitudinally. A diverticulum containing a sloughing ulcer is seen at the lower right band; another is sectioned near the label needle.

CASE 5. (20202.)—The specimen of sigmoid in this case was removed thirteen days after its fixation (two-stage Mikulicz operation) and was consequently too necrotic to permit of satisfactory histologic or gross anatomic examination. Its general appearance

is shown in Fig. 107. It was about 20 cm. long and 10 cm. thick. The walls were thickened with old inflammatory deposits about numerous diverticula. The diverticula were all small and apparently devoid of muscularis in their walls.

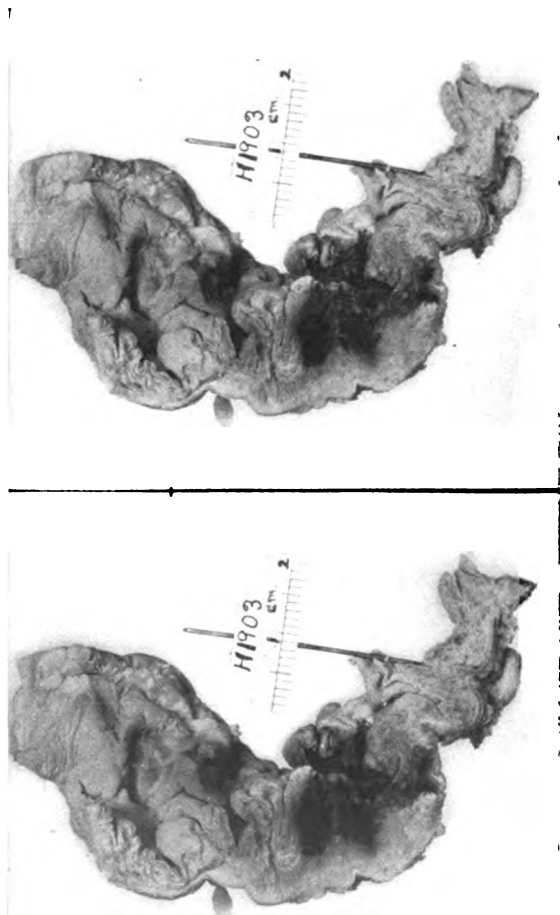


Fig. 99.—Diverticulitis. Case 1. (H1903.) $\times 1$ diam. Section through ulcerated diverticulum shown in Fig. 98.

Summary.—It will thus be seen that of the five specimens herewith reported one contained a true diverticulum and four only false diverticula. It is possible that the true diverticulum (Fig. 100)

may have been congenital, though the relation of the layers of its wall to those of the sigmoid makes the supposition scarcely tenable. One diverticulum (Fig. 99) in this case had formed a sloughing

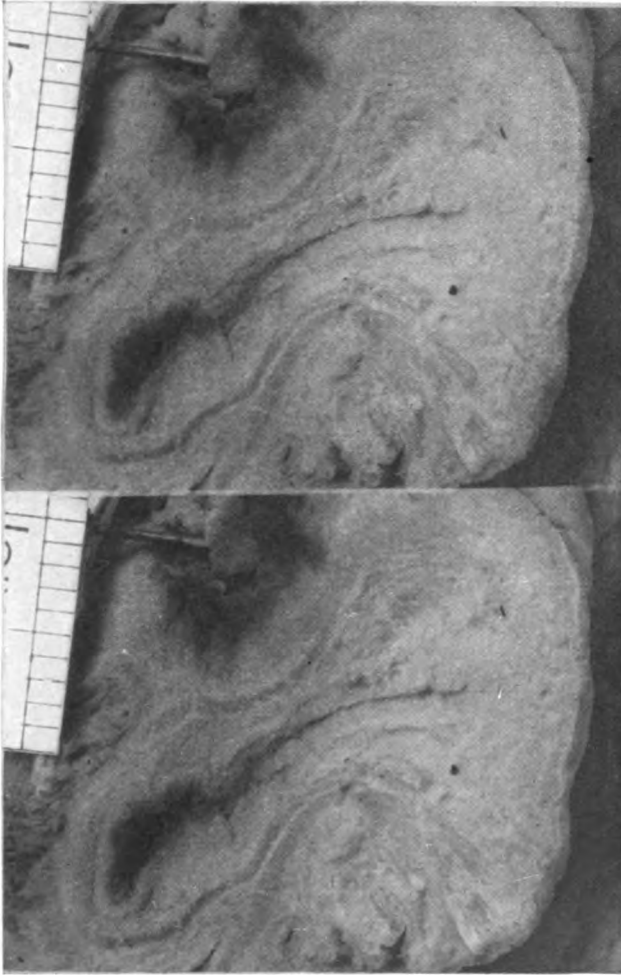


Fig. 100.—Diverticulitis. Case 1. (Htop.) X 3 diam. Enlarged view of sectioned diverticulum shown in Fig. 98. Note muscularis in wall, occluded lumen and inflamed submucosa.

ulcer, simulating in its symptoms and in its gross anatomy an ulcerating carcinoma.

The diverticula in the other four cases were all of the small,

multiple, false variety. All were simple herniæ of the sigmoid walls passing through the circular muscular coat at points where its fibers were deficient. It was impossible to determine accurately

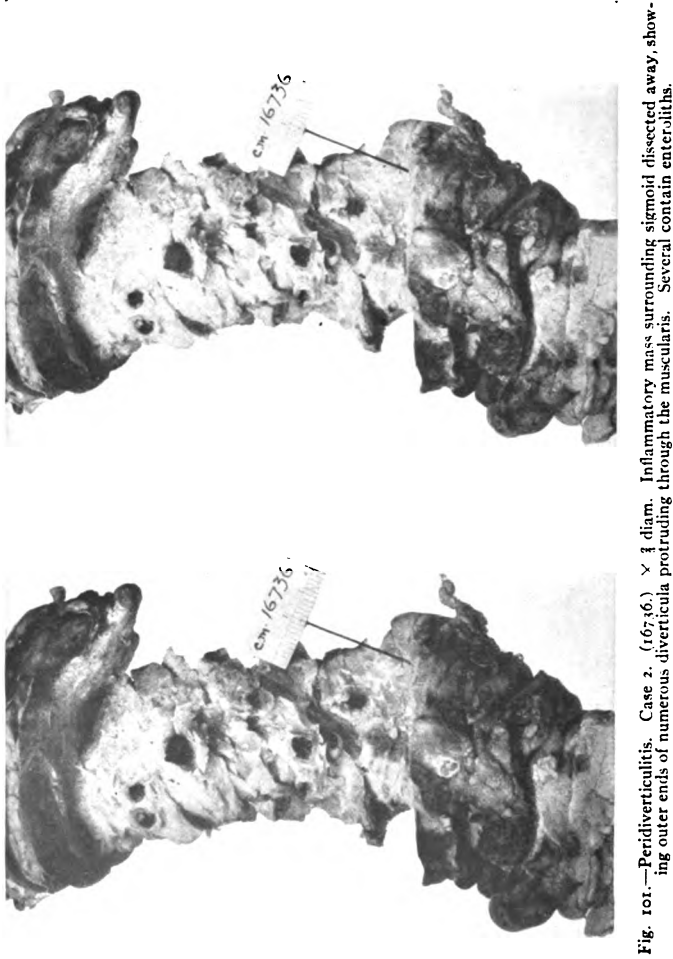


Fig. 101.—Peridiverticulitis. Case 2. (16716.) \times 1 diam. Inflammatory mass surrounding sigmoid dissected away, showing outer ends of numerous diverticula protruding through the muscularis. Several contain enteroliths.

whether this deficiency of the muscularis of the sigmoid walls was congenital or the result of atrophy from the pressure of fecaliths or constipation. It would seem, however, that a congenitally de-

fective musculature, slowly yielding to increased internal pressure, would readily produce the anatomic conditions found.

The large inflammatory deposits about the diverticula were un-

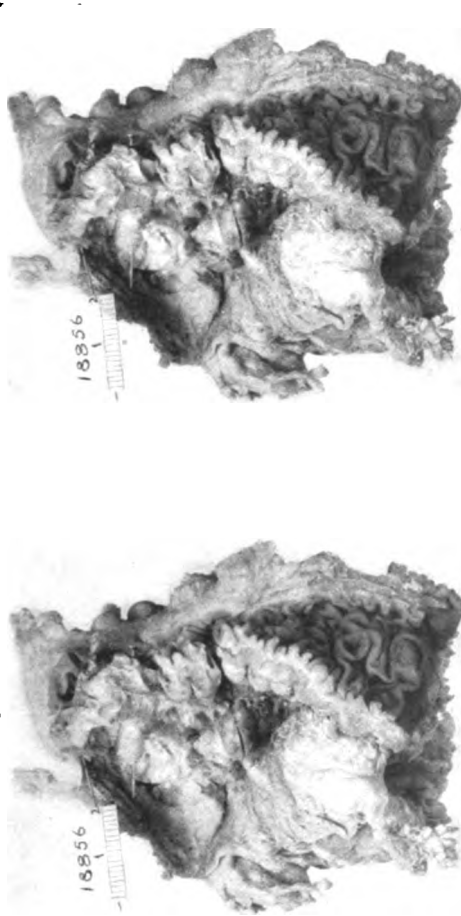


Fig. 102.—Peridiverticulitis. Case 3. (18856.) $\times \frac{1}{2}$ diam. Specimen shows pocketed mucosa, section of sigmoid wall with defective musculature, and two diverticula: one having a pin thrust through it and the other with end removed showing enterolith. The inflammatory mass has been dissected from about the diverticula. A swollen gland is shown.

doubtedly caused by chronic leakage through the diverticular walls. It is noteworthy that this inflammatory reaction was much greater around those diverticula which extended well through the

muscularis, and which contained enteroliths. This is well shown in Fig. 104, an enlarged view of a portion of the sigmoidal wall in Case 4. Here is seen a small diverticulum protruding well through

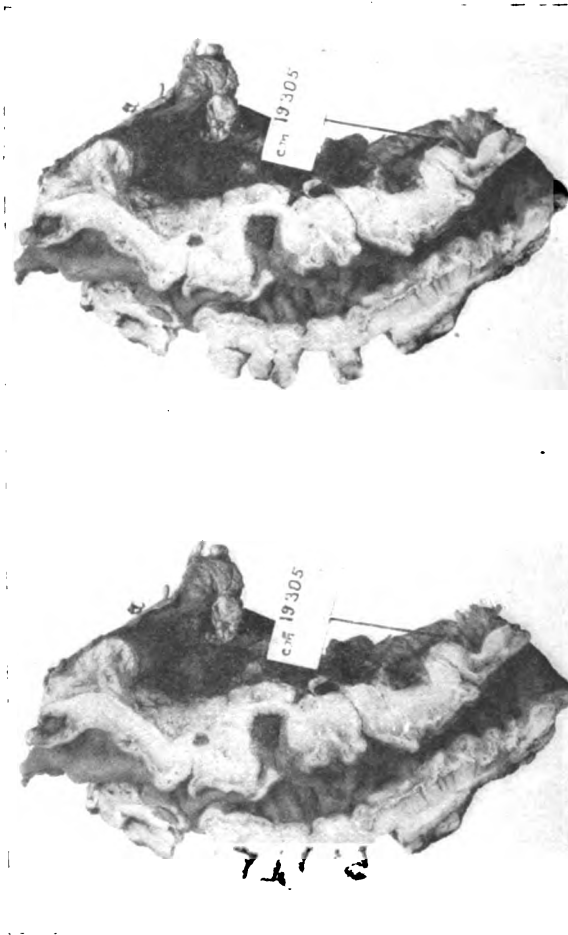


Fig. 103.—Peridiverticulitis. Case 4. (10305.) $\times \frac{1}{2}$ diam. Sigmoid divided longitudinally. Note defective musculature and the diverticula. Inflammatory mass dissected away near label needle.

the muscularis and containing within its almost occluded lumen an enterolith. Around it is an inflammatory mass three times as thick as that around a much larger diverticulum in its immediate neighborhood, but which scarcely penetrates the muscularis, is

still well open into the lumen of the sigmoid, and contains no hard fecal concretion. This one section would seem to go far toward

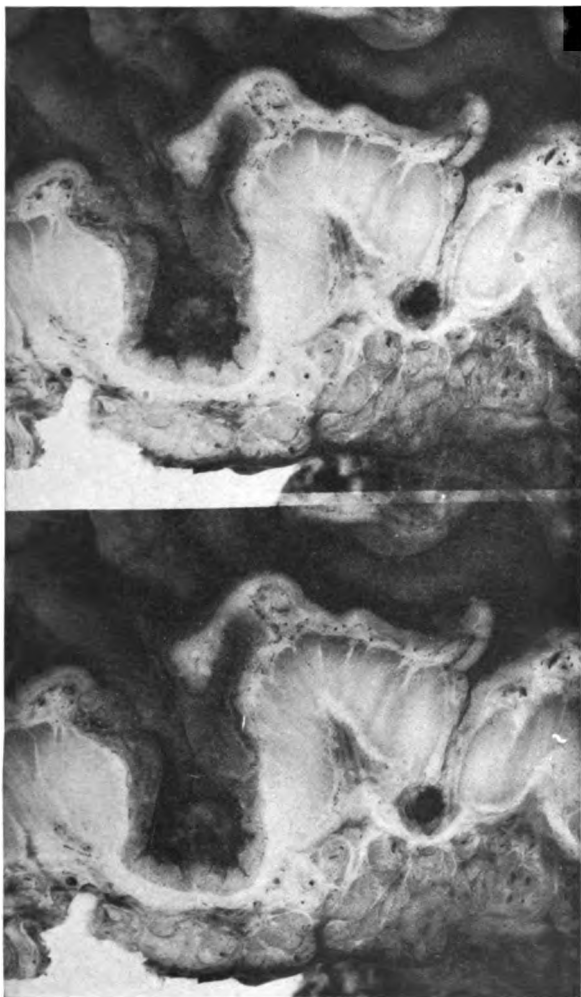


Fig. 104.—Peridiverticulitis. Case 4. (10305.) $\times 2\frac{1}{2}$ diam. Enlarged view of two diverticula, and one point of defective musculature seen in Fig. 103.

explaining not only the etiology of the diverticula, but also of the secondary peridiverticulitis.

It would seem worth while to draw a sharp distinction between the acute ulcerative process within the diverticula in Case 1, and

the chronic inflammatory process confined to the tissues surrounding the diverticula in the other cases. The former is a lesion,

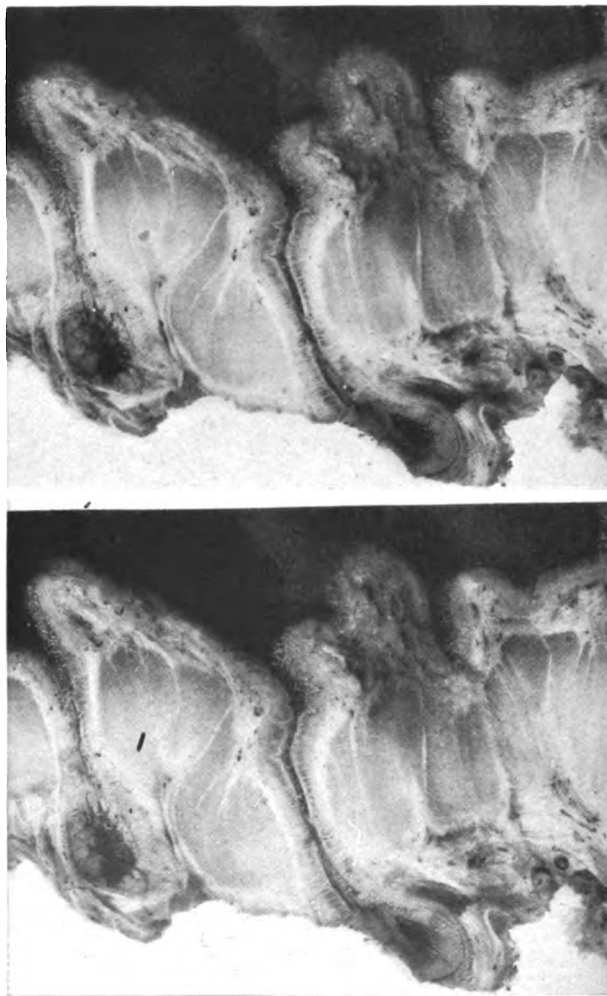


Fig. 105.—Peridiverticulitis. Case 4. (10305.) $\times 3\frac{1}{2}$ diam. Enlarged view of the diverticula, one of which is seen in Fig. 101, the other having been exposed by removing a thin section from the surface shown in Fig. 103. The inflammatory deposit in the subserosa has been dissected away.

primary in the mucosa, caused by bacteria to which it is not immune; the latter, only an inflammatory reaction of the peritoneum set up by the leaking through the diverticular walls of toxins, or

bacteria, with the presence of which the mucosa is constantly familiar. The former causes no material reduction of the lumen of the bowel; the latter, a very marked reduction with chronic obstruction. The former tends to acute perforation into the peritoneal cavity, while in the latter the reparative process is so pre-

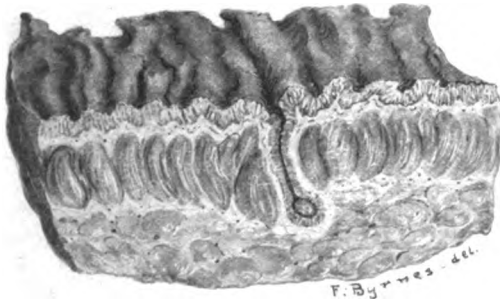


Fig. 106.—Peridiverticulitis. Case 4. (19305.) $\times 1$ diam. Sketch of diverticulum with inflammatory deposit in subserosa.

dominant that rarely should perforation occur. Finally, if we are to speak accurately, we should apply the term “diverticulitis” only to cases of the former type, that is, *acute inflammations of the mucosa within the diverticula*, while the cases of the latter type, that is, *chronic inflammations of the subserosa around the diverticula* should be designated “peridiverticulitis.”

THE CLINICAL COURSE OF ACQUIRED DIVERTICULITIS OF THE
LARGE INTESTINE. (By Dr. H. Z. Giffin.)

Acquired diverticula may be "true" or "false"—the "true" consisting of all the layers of the intestinal wall, the "false" being



Fig. 107.—Peridiverticulitis. Case 5. (20202.) $\times \frac{1}{4}$ diam. External view of necrotic portion of sigmoid resected at second stage of operation.

hernial protrusions of mucosa through musculature. Traction caused by tumors or by adherent organs is probably the most common cause of the "true" variety. The "false" are most

likely the result of excessive pressure from within the intestine, combined with a congenital weakness of the bowels.

Acquired diverticula of the large intestine are more common than those of the small, and pathologic change occurs in them much more frequently. They are usually multiple and may arise from any part of the surface. Some authorities have tried to show that the mesenteric border is the weakest part of the bowel, and that diverticula form here more readily. This seems to be true in the dead bowel, when blood-vessels are not distended and resistant, but the experiments of Chlumsky¹ demonstrate that upon distention of the living bowel, rupture generally occurs at some point opposite the mesentery.

Diverticula often extend into the epiploic appendages and may account for some of the tenderness found in many portions of the gut.

According to a table compiled by Gordinier and Sampson,² acquired diverticula of the large intestine were recorded in 64 examinations out of 8132 autopsies at the hospital of the city of Dresden; in 19 out of 2600 at the Johns Hopkins Hospital; in 2 out of 953 at the Bender Hygienic Laboratory, and in 1 out of 2382 at the Boston City Hospital. It is probable that general interest and careful investigation will show that they occur much more frequently than supposed.

Etiology.—Constipation is considered an important factor in the production of diverticulitis. Hardened feces, becoming impacted in a diverticulum, may be the cause of beginning irritation and possibly of ulceration. This is probably one reason why diverticula of the large bowel undergo pathologic change so much oftener than those of the small; and why the sigmoid is so commonly affected.

Most of the cases occur in persons beyond middle life; the majority are over the age of fifty. The fact that this is the cancer age is productive of obscurity in diagnosis. One of our probable cases, whose age was thirty-nine at the time of examination, gave a history of trouble beginning at fifteen. All other cases were of more advanced age and of much shorter duration—eleven days to

two years. There is apparently no particular reason why some disturbance should not occur early in life, nor why the cases should not be of longer duration.

There seems to be a notable general tendency to obesity. One might conceive this to be a proper concomitant of weakened intestinal musculature.

Chronic passive congestion has been mentioned as a factor in the production of diverticula themselves and also in the causation of disease in them. Dilated veins give a sieve-like character to the intestinal walls, and internal pressure may cause herniæ through the weakened areas. Moreover, after diverticula are formed, improper nourishment will foster inflammatory change.

At our clinic five cases have been seen in which, after resection, the diagnosis has been made certain by pathologic examination. Indeed, this is the only way in which one can arrive at a positive diagnosis.

CASE 1.—Operated upon May 1, 1902, for supposed carcinoma of the sigmoid. O. A., male, aged forty-one, first noticed a tumor in the lower left part of the abdomen five months before admission to the hospital. The patient had lost 30 pounds, was anemic, and practically all of the five months had suffered with pain in the lower part of the abdomen. There had been no urinary disturbance. A tender, hard, irregular, but movable mass was discovered in the left lower quadrant. Six inches of the sigmoid and descending colon were resected. The distal end of the bowel was closed, dropped in, and an artificial anus formed by the upper end. The patient was discharged in eighteen days, evidently in a satisfactory condition.

CASE 2.—J. W., a woman, aged sixty-two, was examined by Dr. C. Graham on November 18, 1905, having been referred by Dr. Caldron, of Mumford, Iowa. Her family history was negative, and she had passed through her menopause at fifty-two, during which time there had been considerable uterine bleeding. For a few years previously there had been noticed at times a sensation of pressure in the lower abdomen, which was relieved only by drastic catharsis. Pelvic pains of an indefinite character had been complained of for a year. On the whole, however, the history was rather negative. Examination disclosed a moderately large mass

low down in the left side of the pelvis, and a tentative diagnosis of ovarian tumor was made. At operation the mass was found to arise from the sigmoid. A resection of 8 inches of the bowel was performed and followed by an end-to-end suture anastomosis. A pathologic diagnosis of fibrolipoma, diverticula, with ulcerating fecaliths, was made. The patient recovered satisfactorily.

It will be noted in this case that there was considerable history of constipation. There had been no attacks of abdominal pain, however, and instead of a mass being found in the left iliac fossa, there was one in the left side of the pelvis. These same points may be noted in Case 4, a woman; and in Sampson's case, also a woman. The male patients we have seen presented a mass higher up. This may be due to the fact that the woman's pelvis is roomy and the sigmoid movable.

CASE 3.—J. W., male, aged fifty-five, weight about 150 pounds, was examined on June 19, 1906, by Dr. W. J. Mayo. The patient gave a history of some gastric flatulence for a year preceding. On June 2 he had noticed some general abdominal pain. Two days later he had a slight chill, and his temperature rose to $101\frac{1}{2}^{\circ}$. A tender, sausage-shaped tumor was discovered in the left iliac fossa. There had been no severe acute abdominal colic. General pain and localized tenderness continued, and the mass gradually decreased in bulk, until at the time of examination it was about one-half of its original size. The patient was 8 pounds under weight. At operation 7 inches of the sigmoid was resected for fibrolipoma, secondary to an ulcerating fecalith. An uninterrupted recovery followed, and the patient is now doing well.

It will be noted in the above case that the onset was sudden and the formation of tumor rapid. The attack of abdominal pain was not as sharp as in appendicitis, nor was there vomiting. Indeed, the absence of vomiting seems to be a common thing unless the attack of pain is very acute.

CASE 4.—W. J. M., a woman aged fifty-two, was examined by Dr. C. Graham on July 31, 1906. She had had typhoid fever twenty-five years previously. There was a history of marked obstruction, and it had been nearly impossible to secure bowel

movement. Five years before there had been an operation for ovarian cyst and some complaint had continued ever since. Intermittent stomach trouble of a mild degree had existed for years. The patient had suffered from periodic attacks of pain across the lower bowel for five or six months, these spells lasting four or five days, never severe, and not accompanied by vomiting. She was 25 pounds below her normal weight. Examination disclosed a left-sided pelvic tumor. At operation, which was done mainly on account of obstruction, the mass was found to be in the sigmoid. This was resected. Pathologic examination revealed a large number of diverticula, some of them ulcerating. There were tuberculous glands upon the peritoneal surface, apparently a secondary infection. The patient died eighteen days after operation from general peritonitis, as postmortem examination showed.

CASE 5.—W. S., aged fifty-two, male, was examined by Dr. H. S. Plummer on January 19, 1907. Five months previously he had, for a week, complained of some pain and nausea. About three weeks before the examination the patient was attacked with severe pain and some fever, lasting two days. There was no constipation and no blood was to be seen in the stools. Dr. Truesdale, of Fall River, Massachusetts, who referred the case to us, had found a mass. There had been a loss in weight of about 26 pounds, with symptoms of obstruction. The patient was very well nourished, weighing over 200 pounds. The possibility of diverticulitis was mentioned upon the clinical report. At operation, 10 inches of the descending colon and sigmoid were resected. The patient died on the thirteenth day, of general peritonitis, as was shown by postmortem.

Beer,³ in 1904, collected eighteen cases of inflammatory disease of the large bowel. S. C. Plummer⁴ reported one case in 1906. The addition of the above five cases of undoubted diverticulitis makes a total of twenty-four. Many cases are reported which in the light of present experience might be considered diverticulitis. Surgeons have at times explored the abdomen, and finding what seemed to be an unremovable carcinoma of the sigmoid, have sewn up, expecting a progressively downward course. To their surprise, a marked improvement has followed. The mass has gradually disappeared and the patient occasionally attained even perfect health.

In other instances a colostomy has been made above a supposedly malignant obstruction, and a surprisingly great improvement has followed. Some of these cases have even been reported as cures of cancer. On the other hand, one must be careful not to consider every left-sided pain as evidence of this malady, until we have seen a greater number of positive instances and have become more familiar with the milder symptoms.

The foregoing five cases must be distinctly separated from the following group of probable cases. Pathologic examination is the only basis for a positive diagnosis. Even macroscopically, at operation, one cannot surely differentiate it from carcinoma. However, the following four cases which have come under our observation simulate diverticulitis so closely that a report of them ought to be of some value.

CASE 1.—The history was kindly furnished by Dr. John W. Bell, of Minneapolis. O. C. W., male, aged seventy, became suddenly ill with chill, fever, and vomiting on February 24, 1906, and a mass was discovered in the region of the sigmoid on deep palpation. Upon operation an inflammatory condition was found about the sigmoid, and there were adhesions, especially to the bladder. These were freed. The patient recovered and is now in excellent health.

CASE 2.—H. C. C., a physician, weight 240 pounds, was examined by Dr. H. Z. Giffin, in July, 1906, and presented an unusually interesting history. The patient's father had died of carcinoma, and the mother of tuberculosis. The patient had been healthy until his fifteenth year, when he had had an attack which was essentially like appendicitis, save that the localization was in the left iliac fossa. Between the ages of fifteen and twenty he experienced intermittently mild paroxysms of pain in the left lower quadrant. When twenty years of age he was put to bed for five weeks with a fever of 104° and 105°, chills, vomiting, distention, obstinate constipation, and severe abdominal pain. After this his general health was good until he was thirty-two years old, when there occurred another attack of abdominal pain, with vomiting and fever, and localization in the left iliac fossa. This was similar to the attack he had had at fifteen. In twenty-four hours a mass as large as a child's head had formed in the region of the sigmoid. Under medical treatment it disappeared in four weeks, and was

thought to have been an abscess, which had discharged by the bowel. The patient was then quite well for a year. When thirty-three, he was kicked in the abdomen by an insane patient, and a small mass formed in the left iliac fossa. There was a large quantity of pus discharged by urethra. This material was examined every day for a month, but no tubercle bacilli could be found. The patient recovered again under medical treatment, but for some months following there was an occasional fever; then the patient was well for four years. On May 3, 1905, he had his third sharp attack, which resembled appendicitis, but with the localization on the left side. A mass formed in three days. Cystoscopic examination and catheterization of the ureters showed only some redness of the left side of the bladder. An abscess was drained by Dr. J. F. Erdmann, of New York. There was a marked improvement and the patient went back to work, but the sinus had persisted to the time of examination. In October, 1905, five months later, there was a fourth attack. A diagnosis of appendicitis with left-sided abscess was made. A median incision by Dr. Erdmann disclosed a normal appendix. A small amount of pus was obtained and the sinus resulting from this had also persisted up to the time of examination. Occasionally there had been a discharge of material having a fecal odor, and twice fecaliths had been obtained. The bowels had been moving quite satisfactorily, and the patient was very well nourished, markedly inclined to obesity, and able to work, having lost but three days on account of a mild attack of pain and fever since examination. The fistulæ still exist.

CASE 3.—M., a Bohemian, fifty-one years of age, male, presented himself in 1896, with symptoms of an enterovesical fistula. There was a history of symptoms similar to appendicitis, save that the localization of pain was on the left side. His condition improved for a while, but later became worse, and a mass which was quite tender developed in the left side of the abdomen, low down. A discharge of pus with a fecal odor occurred by urethra, and continued though the bowels were moving naturally. A diagnosis of appendicitis with left-sided abscess was made. At operation, however, the appendix was found to be normal, but in the pelvic portion of the sigmoid there was a moderately large, sausage-shaped tumor imbedded in a mass of adhesions and attached to the bladder. This was stripped away, and an attempt made to close both the bladder and the bowel openings. Combined fecal and urinary fistula developed in a week. The urinary fistula healed by granulation rather promptly, but the fecal fistula persisted, and when the

patient was last seen, two years afterward, there was still occasional discharge of gas and hardened fecal masses.

CASE 4.—P. V. R., a clergyman, sixty-three years of age, weighing 260 pounds. The history was furnished by Drs. J. B. McGaughey and W. F. C. Heise, of Winona, Minnesota. The illness dated from August, 1905, when there were occasional attacks of moderately severe pain across the lower abdomen, associated with diarrhea. These attacks grew worse in December, 1905, and in January, 1906, he was taken down with fever ranging from 99° to 102°, which continued three weeks. During this time there had been two spasmodic attacks of pain which required morphin. The pain was localized in the left inguinal region, and seemed as though it might have been due to a stone passing through the ureter. There was, however, no blood nor gravel in the urine. After the disappearance of the fever, there occurred a third similar attack. The pain continued intermittently during the spring, and in mid-summer the patient started for Europe in the hope of improving with change of scene and climate. In August the pain became worse, and during the latter part of September a swelling and a tender area developed in the left inguinal region. The patient's physician in Berlin advised him to return home. Upon his arrival, in the latter part of October, he was found to be 20 pounds under weight, and an indurated area, apparently inflammatory, had developed along the course of Poupart's ligament, extending into the testicle. Upon lancing this, pus, blood, gas, and fecal matter were obtained. Five or six days later an intestinal obstruction ensued and was relieved by colostomy on October 28, 1906 (operation by Dr. W. J. Mayo). There followed an immediate improvement both in local and in general conditions. Six weeks after operation the bowels moved, per rectum, for about three weeks. Since then the feces have passed per rectum intermittently. The pelvic abscess continued to discharge pus and blood until March 21, 1907. The colostomy wound has been gradually growing smaller. The patient complains of pain when constipated, and there is some hurry in urination. There was so much urinary disturbance at one time that a stone in the bladder was suspected. Cystoscopic examination was done by Dr. M. C. Millet, but proved to be negative. The patient has now regained most of his loss in weight, and is gradually getting back to his work.

We have presented five *positive* and four *probable* cases of diverticulitis. All of the positive cases and most of the probable ones

were over forty years of age, and all were within the common cancer limit. Of the positive cases, two (women) presented left-sided pelvic masses with obstructive symptoms; and in three cases (men) there were left iliac tumors with abdominal pain localized in the left lower quadrant. The history of acute attacks of abdominal pain, first general and then localized in the left iliac region, with or without vomiting, is striking.

Of the probable cases, three proceeded to abscess formation, and two had enterovesical fistulæ. One caused a complete stenosis.

Beer³ classified the cases which he had collected into: First, those which produced stenosis, of which there were six instances. Second, those in which perforation into the peritoneum had occurred. He draws attention to the fact that the sigmoid should be examined in all cases of perforative peritonitis, when in doubt as to the source. Third, those which led to abscess formation. Fourth, those with intestinovesical communication. In twenty cases of these fistulæ, Chavannaz found nine inflammatory, five tubercular, four carcinomatous, and two traumatic. The frequency of the inflammatory form will be noted. Fifth, those which seemed to show some causative relation between diverticula, mesenteritis, and volvulus of the sigmoid. Sixth, instances of appendicitis in which diverticula had been found in that organ. Seventh, those in which carcinoma had apparently developed in false diverticula. Hochenegg⁵ has reported one such case.

Clinical Diagnosis.—A clinical diagnosis of diverticulitis cannot be made positively. Left-sided pain low in the abdomen, coming in spells, and associated with constipation, brings it to mind. The occurrence of a more acute abdominal pain, general at first, and later localized to the left iliac fossa, would suggest it very strongly. The rather sudden formation of a mass in the left lower quadrant, following such an attack of pain, would make the diagnosis yet more probable. Carcinoma would have been more gradual in growth, but this point cannot be relied upon from the fact that the patient may not have noticed such a mass at its beginning. The occurrence of blood mixed through the stools is an important sign in favor of carcinoma. Only one of our cases was correctly diagnosed.

The following case is instructive from a diagnostic standpoint:

J. T., aged fifty-three, was examined by Dr. H. Z. Giffin on July 30, 1906. There was an old history of stomach trouble, suggesting ulcer. Two weeks previous to examination he had had a severe attack of epigastric pain, colicky in character, coming on and disappearing suddenly. Morphin was required. Three more attacks, lasting about twenty minutes each, followed during the day. Eleven days before examination the patient had noticed tenderness and the formation of a mass in the left lower quadrant. Repeated irrigation of the bowel failed to remove this. He had been having six or seven stools a day, none containing blood. He had lost about 20 pounds in two weeks, but had eaten nothing. Sigmoidoscopic examination was negative, the mass being too high. The hemoglobin was 90 per cent.

From the above history one would have expected an inflammatory growth, but at operation a cancer of the descending colon and sigmoid was found and excised. It is impossible to tell even by the gross appearance of such a tumor whether it is inflammatory or malignant. Microscopic examination alone can positively diagnose the condition. In women one must think of the possibility of diverticulitis upon finding a left-sided pelvic tumor, especially if associated with much bowel trouble.

Actinomycosis of the sigmoid may occur. Tuberculous peritonitis may be localized in this region. Appendix abscess may be left-sided and chronic sigmoiditis may cause a thickened and palpable gut. In these instances the previous history will generally give a clue. It is also said that normal epiploic appendages may be enlarged, tender, and suggest the existence of a mass.

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HERNIA

RADICAL CURE OF UMBILICAL HERNIA*

By WILLIAM J. MAYO

The older methods of operation for the radical cure of large umbilical hernias were so unpromising that few surgeons cared to attack them unless forced to do so by acute conditions. Not only was the prospect of relief uncertain, but there was considerable danger attending the operation itself because of increased intra-abdominal tension, as the recognized procedure was to dissect out the recti muscles and transplant them to the median line.

These patients are usually obese, with thinned-out recti muscles widely separated, so that when brought in apposition they have but little retentive power, even if the tension which is necessarily put on them is sufficient to maintain them in position.

The hernial opening lies above the attachments of the urachus and remnants of the hypogastric arteries in the umbilical scar. That these three structures exercise some influence is evidenced by the fossa which they normally outline in the peritoneal cavity. Below the umbilicus the recti muscles are in close apposition, all of the aponeurotic structures of the abdominal muscles passing in front of them. Above the umbilicus there is three-fourths of an inch or more separation between the recti, due to the fact that here these muscles are completely ensheathed in the tendinous aponeurosis of the external and internal oblique and the transversalis muscles.

In 1894, in an operation for the radical cure of umbilical hernia along the old lines, a wide transverse incision was made for the purpose of bringing the greatly separated recti muscles in apposi-

* Reprinted from "The Journal of the American Medical Association," June 1, 1907, vol. xlviii, pp. 1842-1844.

tion. The muscles were found at least 6 inches apart and so thinned out as to render futile the idea of bringing them together. This led to the necessity of overlapping from above downward all of the aponeurotic structures of the abdomen to close the transverse operative gap. Without quite realizing the importance of the step which was accomplished in this case, I devised a method for the cure of umbilical hernia, by overlapping from side to side without any attempt to find the muscles (similar to the Blake operation). But in more than half of the cases in which this was attempted, sufficient overlapping could not be accomplished successfully, and I was forced back to the "above-down" plan, and found that in this way the largest protrusions could be satisfactorily reduced and the hernial opening closed without tension.

If a fleshy patient with umbilical hernia is laid flat on an examining table, it will be found that the anterior abdominal wall has become so stretched that the "slack" is considerable, so much so that if the right hand is placed below and the left hand above, the abdominal wall can be made to cover and overlap the lower hand completely. This stretching of the abdominal wall in the median line between the ensiform cartilage and the pubes may amount to from 4 to 10 inches. If the patient is now asked to raise the body from the table, setting into action the recti muscles, they will be found to be displaced laterally to about the same extent. This over-stretched condition of the abdominal wall is brought about as a result of the increased weight of the pendulous abdomen. As a person gains in weight the spine gradually becomes more erect in posture, and in the very fleshy individual the spinal column is bent backward, the weight of the head, neck, shoulders, and upper thorax being used to counterbalance the abdomen. It is for this reason that the overlapping from above-down method of cure is so easy in the very obese with large hernias, relatively much more so than in thin persons with normal abdominal walls.

The tendinous aponeurotic structures involved in the operation are among the strongest in the body, and when overlapping is accomplished, the resistance is nearly perfect. The sutures merely maintain the structures in apposition, while the intra-abdominal

tension itself prevents displacement. It can be aptly compared to a steam boiler. If the boiler door is on the outside, it requires great force to maintain its resistance to the pressure, whereas if the door is placed on the inside, the greater the pressure within, the more tightly is the opening closed.

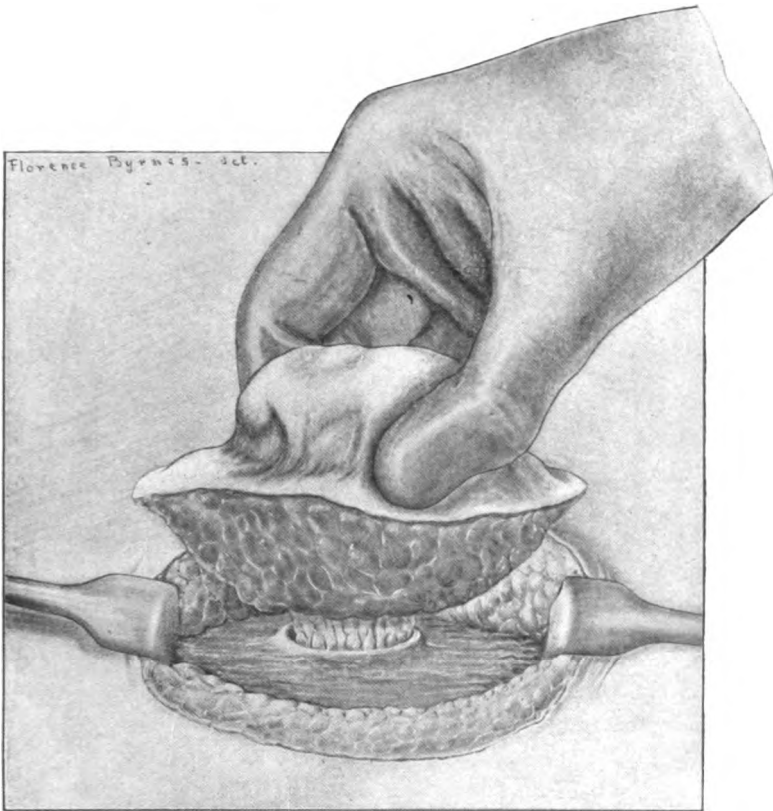


Fig. 108.—Removal of sac, adherent omentum, and skin.

The operation is extremely simple. Two transverse elliptic incisions are made, cleanly exposing the neck of the hernial sac and the aponeurotic structures for several inches above and below it. The neck of the hernial protrusion is cleared as high as the aponeurotic structures extend. The sac is then opened and any intestine

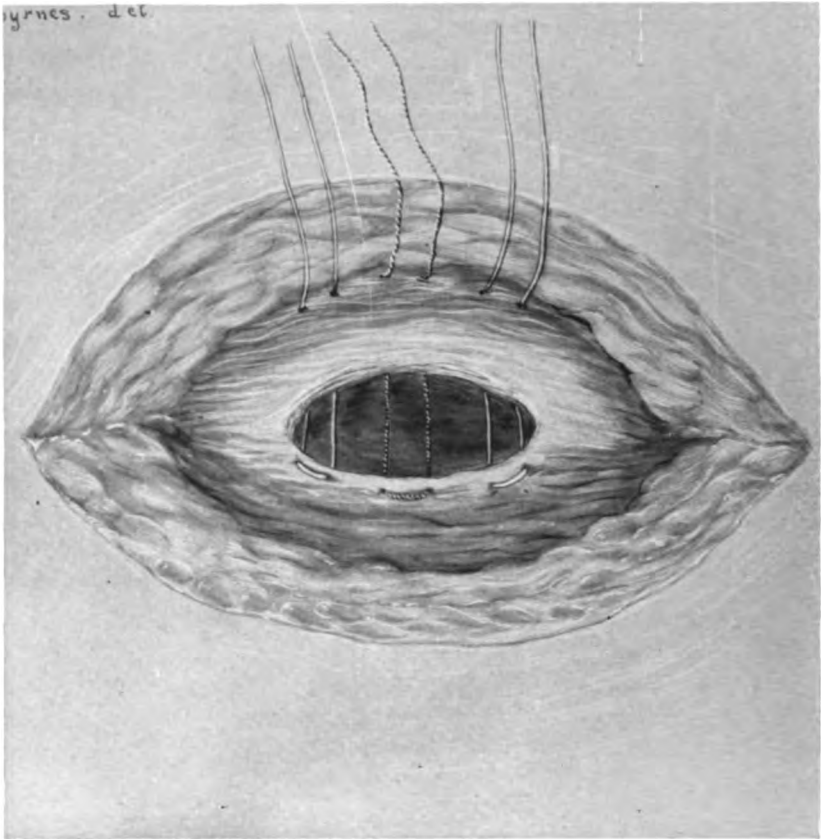


Fig. 100 —Suture of the aponeurotic and peritoneal structures; sutures placed.

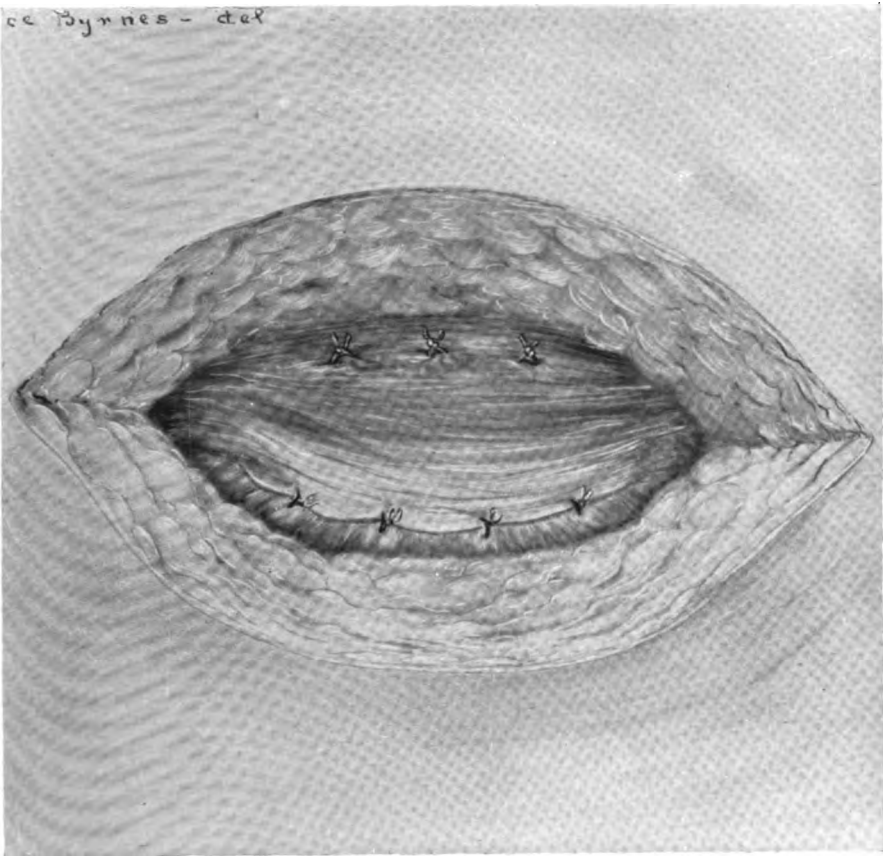


Fig. 110.—Sutured aponeurotic and peritoneal structures.

which may lie in it is returned into the abdomen. The contained omentum, if such there be, is ligated in sections on a level with the abdominal orifice, and the stumps returned into the peritoneal cavity. The sac, with all of the adherent omentum, including the skin, is cut away without further manipulation (Fig. 108). A stout curved needle threaded with strong celluloiden linen is passed from without in through the aponeurotic structures and peritoneum from 2 to 3 inches above the margin of the opening.

To guard the needle as it enters the peritoneal cavity the bowl of a large tablespoon, as recommended by Monks, is a valuable aid. The needle and thread is drawn down and out of the hernial opening. A firm mattress stitch is now caught in the upper edge of the lower flap, about $\frac{1}{4}$ of an inch from the margin; the needle is then carried back through the hernial opening into the peritoneal cavity and made to emerge $\frac{1}{4}$ of an inch lateral to the point of original entrance. On each side of this is introduced a similar mattress suture of strong chromicized catgut (Fig. 109). These three sutures are drawn tight, pulling the entire thickness of the aponeurotic and peritoneal structures behind the upper flap. The margin of the upper flap is now retracted to expose the suture line, and if any gap exist it is closed with catgut sutures. The upper flap is now sutured to the surface of the aponeurosis below by continuous chromicized catgut suture (Fig. 100) and the superficial fat and skin closed. Patients are confined to bed from twelve to twenty days.

There are two modifications in the plan outlined above, for which I am indebted to Dr. A. J. Ochsner. In the operation as originally performed the hernial opening was incised laterally and the peritoneum was separated from the upper flap, the lower being drawn upward into a pocket. These steps are unnecessary.

The above-down overlapping method for the radical cure of umbilical hernia I first presented in a paper before the American Academy of Railway Surgeons at the annual meeting in 1898.* In a second paper, read before the American Surgical Association in 1901,† the method was again brought forward. In a third article

* "Ann. of Surg.," Jan., 1899.

† "Trans. of Am. Surg. Assn.," 1901, and "Ann. of Surg.," May, 1901.

on the same subject, read before the Surgical Section of the American Medical Association at the annual meeting in 1903,* some further experiences were noted.

The object of this fourth communication is to call attention to the ultimate results, as more than thirteen years have elapsed since the first operation was done. During this time one hundred and twenty-six umbilical hernias and fully as many postoperative hernias, especially those following appendicitis and gall-stone operations, have been performed by this method, almost without a relapse.

Of the eighty-eight patients with umbilical hernia who were operated on between 1894 and 1905, seventy-five were traced. One had a partial relapse; her physician described it as a boat-shaped stretching at the site of the former operation, but stated that it did not inconvenience the patient. Another patient, supposed to have suffered a relapse, was operated on and a second opening found above and lateral to the closed umbilical opening.

* "The Journal," July 25, 1903, 225.

INGUINAL HERNIA—TYPES OF OPERATION— RESULTS IN 1652 CASES *

By E. S. JUDD

Within the past sixteen years 1652 operations for the radical cure of inguinal hernia have been performed in the clinic at St. Mary's Hospital, Rochester, Minnesota.

In the 1429 persons operated upon, 1310 were males and 119 females. Although all trades and occupations were represented, by far the greater number of these patients were farmers and day-laborers. The youngest patient operated upon was three weeks old, the oldest nearly ninety years of age. Both were operated upon for the relief of strangulation. Eighty of the patients were under five years of age, 127 between the ages of five and twenty, 992 between twenty and fifty, and 230 were over fifty years of age. Of this number, 728 were right-sided, 426 left, and 230 double. Many of these patients had worn a double truss where only a single hernia existed. This fact may account for the larger percentage of double hernia than is reported by Coley and Stiles, who have confined their work to children.

Varieties.—Fortunately, the oblique or external variety, with the neck of the sac lying external to the deep epigastric artery, forms the greater bulk of cases, as they are easier to repair and are not so apt to give trouble later. Of 1652 cases, 1451 were of this variety. There were 183 direct hernias, including all of the anatomic direct, having the neck of the sac in the internal fossa, and the type which begin as oblique and, through gradual increase in size and the constant pressure of a truss, are so changed that the

* Read before the Minnesota State Medical Association, August 13 and 14, 1907. (Reprinted from "The Journal of the Minnesota State Medical Association and Northwestern Lancet," Feb. 15, 1908.)

rings almost overlie each other. In addition to these, there were 14 cases that were essentially direct hernias, but they were in a class by themselves, in that they contained the bladder. This particular class of cases is interesting, not only from the fact that they contain the bladder, which could easily be injured during operation, but because it is the type most difficult to repair, and gives the largest percentage of recurrences, with the possible exception of the sliding hernia. In one instance the bladder was opened during operation, but the condition was recognized immediately and the wound closed with drainage, the patient recovering with a cure of the hernia.

Of the interparietal variety there were five cases, one preperitoneal associated with undescended testicle, in which the protrusion was toward the bladder. This was the only case under twenty years of age that relapsed. The sac was not properly cared for; the relapse was noticed as soon as the patient was allowed to be up. Operation for recurrence was performed a few weeks later, and the patient has remained well for a year. One case was interstitial, the sac lying between the internal and external oblique muscles. The remaining three, one of which was double and one single, were superficial. In each instance the sac came out of the external ring and turned up over the aponeurosis of the external oblique, the testicle lying just outside of the external ring.

There were 14 sliding hernias in the series: 8 on the left side involving the sigmoid, and 6 of the cecum on the right side. These were not all complete, as several of them had a small sac of peritoneum on the inner side and a sliding of the intestine through the internal ring on the outer side. In some of them there was no peritoneum at all. Three of these cases recurred through mistaken judgment in attempting to repair them without transplantation of the cord.

Congenital inguinal hernia, in the strictest sense, is very uncommon. In 112 of these 1652 cases there was no apparent attempt at obliteration of the vaginal process, and at the time of operation there was direct communication between the tunica vaginalis and the peritoneum. There is no mention in the histories of the pro-

trusion at the time of birth. In all probability many of the sacs are congenital and have become hernias later in life. The obliteration of the vaginal process begins near the central portion and normally extends in both directions, so that the peritoneum and tunica vaginalis are separated from each other, but that part of the vaginal process between the starting-point of obliteration and the internal ring may remain as a congenital sac. One point that may dis-

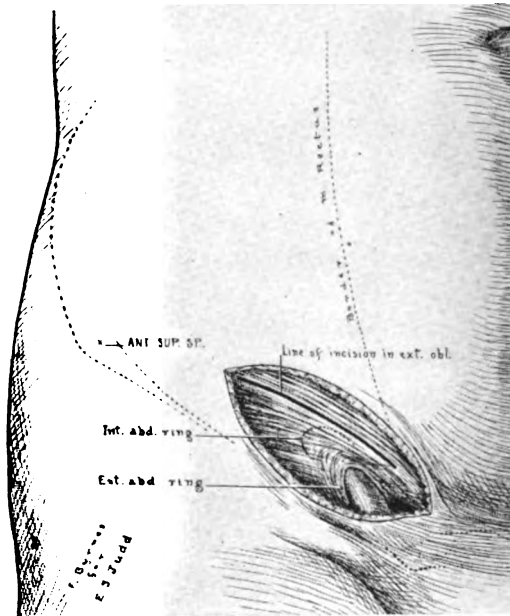


Fig. 111.—Line of incision in external oblique muscle.

tinguish a congenital sac from an acquired sac is the condition of the fibrous ring at the neck. In the acquired variety this would not be a firm fibrous ring, but, rather, the irregular scar of torn tissue.

Attention has recently been called to the number of right inguinal hernias which develop from three months to a year after operation for appendicitis. There have been about twelve of these cases in this clinic within the past two years. Although these

operations for appendicitis were performed by various operators, the gridiron incision was the one usually employed. The question arises as to whether the disturbance in the nerve-supply to the internal oblique in doing the appendectomy had not caused an atrophy of the muscle, and thus weakened the inguinal region.

Barring accidents, such as pneumonia, emboli, and sepsis, there should be no mortality in the radical operation for the cure of inguinal hernia. One of the above series died of pneumonia, one of pulmonary embolism, and one of sepsis. Of 38 strangulated and 11 incarcerated, 3 strangulated were fatal. Each of these

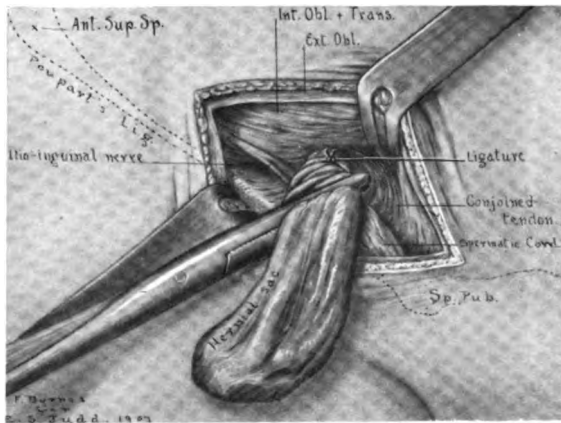


Fig. 112.—Showing twisting of hernial sac.

three cases required extensive intestinal resection, and all were in old people.

Recurrences.—Seventy per cent. of all recurrences came within the first six months, and 90 per cent. within the first year. Of the 42 recurring cases, 25 were operated upon in our clinic, and 2 of these required a third operation. The other 18 cases had the second operation performed elsewhere.

The simple anatomic operation without cord transplantation was performed 1241 times, and so far as these cases can be traced there have been 21 recurrences. A few of these came from infection, but the greater number came from trying to make this operation do for all classes of cases. Three of these recurrences were in slid-

ing hernias, 2 in bladder hernias, and 5 in direct hernias. The recurrence invariably came along the cord and showed just above the pubic bone.

Of 411 operations with cord transplantation there were 4 recurrences. In all but one the recurring protrusion came above the internal ring. In this one case there was a small opening at the lower angle and recurrence at this point. It will be seen that the percentage of recurrence was less than one where the cord was transplanted, and over one where it was not transplanted; therefore we might conclude that the cord should be displaced every

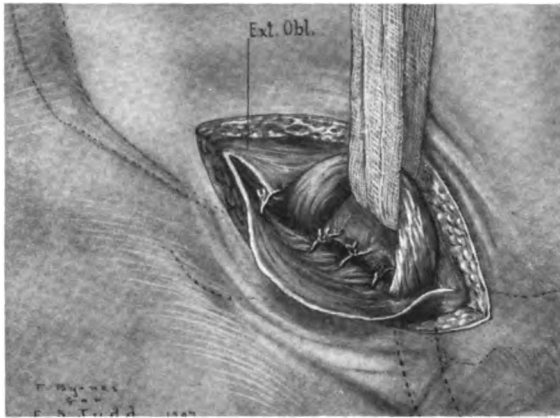


Fig. 113.—Showing method of transplanting the cord.

time. This, however, is not so, as the simple anatomic operation, leaving the cord and testicle as nearly undisturbed as possible, is the operation of choice. This method restores the anatomy of the region and will be attended with a low percentage of recurrence if properly employed.

The strength of the closure depends almost entirely on the internal oblique muscle, it being the only structure in this region with abundant blood- and nerve-supply. In an individual with oblique rupture this muscle differs from the normal in its short line of origin from Poupart's ligament, although it passes inward as a good heavy muscle and unites with the transversalis to form the conjoined tendon.

If the rupture is direct to start with, or has become so from long standing and crowding of a truss (bladder hernia), or if there is a great deal of fat along the cord, as is seen in fleshy people with overhanging abdomens, the internal oblique will have its same origin from Poupart's, though its fibers at the point of union with the transversalis will be so atrophied and thinned out by pressure that in the extreme cases there is almost an obliteration of the conjoined tendon. Knowing that the most likely point of recurrence is along the cord, it is not reasonable to have the cord supported by the thinned-out muscle, and in this class of cases the cord should be transplanted. In so doing, the possible point of recurrence is transferred from an atrophied tendon to a good body of muscle. This procedure is not necessary in the ordinary oblique rupture, as good muscle extends the entire distance to the conjoined tendon.

Technic.—An incision is made through skin and superficial structures from a point 1 inch above the internal ring to the external ring, not extending to the scrotum. The superficial veins are clamped and cut and the external ring is located. The aponeurosis of the external oblique is incised parallel to the line of its fibers at a point just internal to the internal pillar of the external ring, and the incision is continued well up over the internal ring. The external ring is left intact except in the large irreducible hernias. Poupart's ligament is cleared well down with a piece of gauze or blunt dissector so that the lowest part of the shelving edge is exposed. The weak point is readily located with the finger near the internal ring, the cremaster and transversalis fibers are separated with a pair of blunt forceps, and the neck of the sac is grasped. As soon as the sac is separated from the surrounding structures by brushing them back with a piece of gauze, a small opening is made in the neck, and one finger slipped into it makes the rest of the dissection quick and easy and without danger to the cord structures. Adherent structures inside the sac are attended to; the omentum is saved as much as possible. It will sometimes help in reducing intestine or omentum to twist the sac, beginning at the distal point. After the contents are reduced, the twisting is continued, and in this way the peritoneum tracted well out. Crushing the neck before ligating breaks

the intima of the vessels and starts early healing. The neck is then ligated, the ligature passing through the neck to prevent its slipping. An examination of the internal oblique muscle decides whether or not to transplant the cord.

If the anatomic or simple operation, which is in principle the Ferguson, Andrews, or Girard, is performed, in many instances the cord structures will not be visible at any stage of the operation. The deep sutures of plain heavy catgut are started at a point just above the internal ring, and pass through the internal flap of the aponeurosis of the external oblique, taking a good bite into the

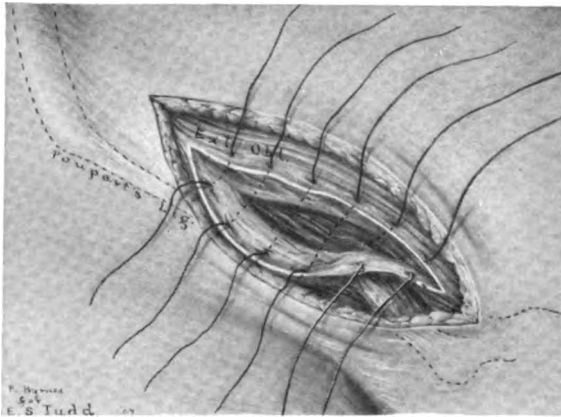


Fig. 114.—Deep stitches placed in the simple operation.

internal oblique and transversalis, and then pass across to a low point on the shelving edge of Poupart's ligament. Three or four of these stitches will be sufficient in most cases. The lowest stitch is under the external ring, and is made so that it allows just room enough for the cord to pass without constriction. The stitches should avoid the ilio-inguinal nerve, and be tied only tight enough to approximate the muscle and ligament. The external oblique aponeurosis is caught in these stitches to help hold the internal oblique over and so strengthen the entire area, and also help in the imbrication, which is the next step.

The principle of imbrication is taken from the operations of

Lucas Championnière and Andrews, and is accomplished by placing the external flap of the aponeurosis of the external oblique (which continued outward is Poupart's) over the internal flap, and suturing these so as to get a surface instead of an edge-to-edge union. The internal pillar of the external ring is set in far enough to fold the external ring to the proper size. This flap is caught into place by two or three stitches of heavy catgut. The superficial fascia is closed with a running catgut, each stitch dipping through the two flaps of aponeurosis of the external oblique, making

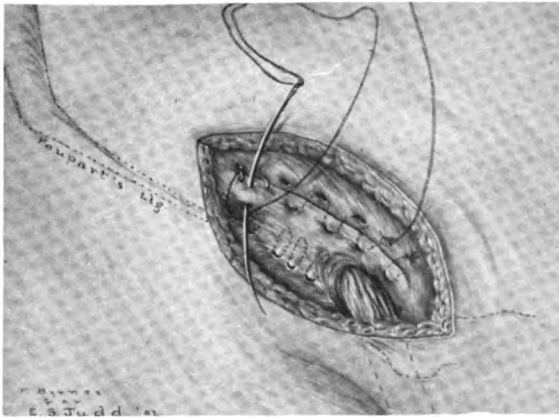


Fig. 115.—Method of overlapping the aponeurosis of the external oblique.

a running mattress stitch as well. The skin is closed with the same catgut, subcuticular.

In case the type of operation with transplantation of the cord (Bassini or Coley) is decided upon, the cord is separated freely from the surrounding structures and held aside with a piece of tape, and exactly the same structures approximated with the deep sutures as in the simple type, except that in this case the suturing is done posterior to the cord, and in addition one stitch is put above the cord to fold the muscle onto Poupart's at this point. In many operations of this type it will be necessary to open the sheath of the rectus, and catch this muscle in the lowest stitches, in order to close well the lower angle. It is very essential that the deep stitching continue

to the pubic bone, and so, according to Bloodgood, the occasional use of the rectus, where the conjoined tendon is obliterated. In imbricating the flaps of the external oblique aponeurosis, the cord structures lying on the first row of stitches must be avoided.

In the female the round ligament is not transplanted. One deep stitch passes half through the ligament to prevent its slipping and losing its support to the uterus. Otherwise the technic is identically the same as the simple operation in the male.

The wounds closed, subcuticularly, are dressed with dry sterile gauze and adhesive straps. The simple type of cases will remain in bed eight or nine days; the fleshy subjects, or those with direct hernia, ten to twelve days. Any support that makes pressure over the healed incision is dangerous, as it will tend to separate and produce atrophy of approximated tissues; therefore, every patient is advised against the use of a truss. The very fleshy individual with a large abdomen will feel more secure with an abdominal supporter, and this does no harm.

MESOCOLIC OR RETROGASTRIC HERNIA*

By WILLIAM J. MAYO

A review of the literature on rare forms of intra-abdominal hernia, for which I am indebted to Dr. D. C. Balfour, leads me to the conclusion that the following two cases are sufficiently unusual to warrant a report of them. It is interesting to note that notwithstanding the peculiarity of the conditions, the operative findings were practically identical, and the original pathologic lesions were the same in each instance. Both patients came under observation and were operated upon during 1908.

CASE I.—Mrs. K., aged fifty-nine, gave a history of having had, during the past fifteen years, attacks of severe “indigestion,” *i. e.*, epigastric pain of a crampy character coming on one-half to one hour after meals, reaching its greatest severity three or four hours later. This pain was accompanied by much gas and sour, burning eructations. The patient would frequently vomit immense quantities of undigested food-remnants, sometimes streaked with flecks of blood, when the retching was severe. Several times she had vomited food known to have been eaten a week previously. Her bowels were irregular and she had been troubled a great deal with flatulency and occasionally with general abdominal cramps. She had lost much in weight, strength, and appetite, and was in an emaciated condition when she presented herself for consultation.

On examination, marked visible peristalsis was found over the whole abdomen, and a peculiar fullness and resonance in the upper abdominal zone. Air dilatation showed the lower stomach border just over the pubes. The stomach contained food-remnants after fourteen hours. An examination of the contents after an Ewald test-breakfast showed total acidity, 75; free HCl, 65; and combined HCl, 10. At this time there was no evidence of any occult blood

* Reprinted from “Annals of Surgery,” April, 1909.

in either the stomach contents or feces. The marked anemia present was found to be the simple secondary form.

From the history obtained from the patient, together with the physical examination, it was evident that pyloric obstruction was present, probably due to a long-standing ulcer near the outlet of the stomach, and an exploration was advised.

The operation was performed at St. Mary's Hospital, May 30, 1908. The abdomen was opened by a median incision above the umbilicus, and the distended intestine came at once into view. The stomach was completely covered with the small intestine. The mesentery was traced to an opening in the gastrohepatic omentum which allowed the ileum and jejunum to lie above and in front of the stomach. On reduction a huge rent of the mesocolic omentum was found, through which the entire small intestine, with the exception of the first 3 inches and terminal foot, and the whole extent of the mesentery had passed into the lesser sac of the peritoneum behind the stomach and out through a second opening in the gastrohepatic omentum. The opening in the mesocolon was at the exact site where this structure is split to admit of the usual posterior no-loop gastro-enterostomy, and extended up to the circle of the middle colic artery (Fig. 116). The openings in both the mesocolon and gastrohepatic omentum were about 5 inches in diameter and the margins were round and smooth, the condition evidently being of long standing. There was no limiting peritoneum or sac. Four inches from the origin of the jejunum was a marked groove where the intestine had hung over the lesser curvature of the stomach. After reduction, the hernial opening was closed by suturing the margins with linen to the posterior wall of the stomach.

There was a large ulcer of the duodenum present extending up to the pylorus, adherent behind and causing a most marked grade of obstruction, for which a posterior no-loop gastrojejunostomy was performed.

The patient made an uneventful recovery, left the hospital on the eleventh day, and was discharged eighteen days from the date of operation.

CASE II.—Mrs. S., aged thirty-two. Although comparatively a young woman, this patient had a history of stomach trouble extending over a period of some twenty-five years, having had since a child attacks of severe epigastric pain, radiating through to the back and associated with much gaseous distention and frequent vomiting. These attacks had no constant relation to meals, and

the intervals between them varied greatly in duration. During these latent periods the patient would enjoy comparative comfort, and at one time was free from all symptoms for some four years.

Recently, however, the condition became aggravated, the attacks more frequent, and the pain often severe enough to require morphin. She had acquired the practice of relieving her distress by drinking large quantities of water to induce vomiting; the washings always contained food-particles. On air-distention the stomach was found to be greatly dilated and contained food-remnants after

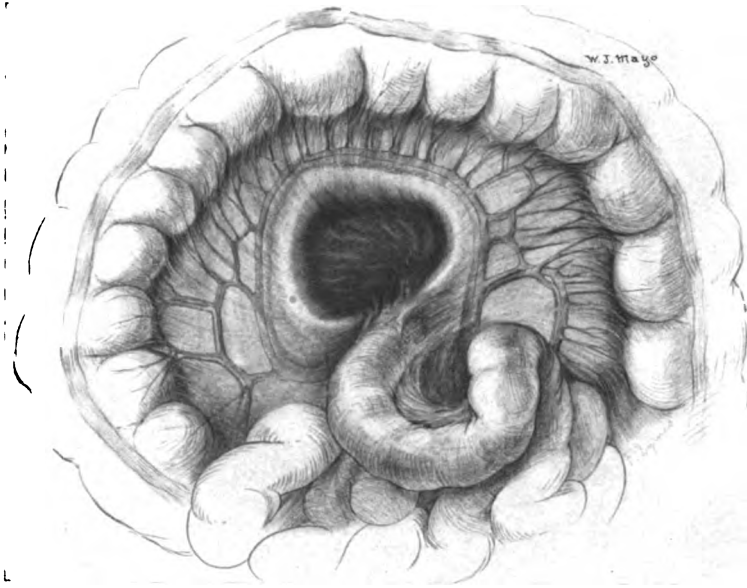


Fig. 116.— Showing the hernial opening in the transverse mesocolon.

fourteen hours. Ewald breakfast showed moderate free acid and occult blood, but was unsatisfactory because of the great retention.

The patient was operated upon December 5, 1908, at St. Mary's Hospital. On opening the abdomen by an incision above the umbilicus a peculiar tumor above the stomach presented as a hernia-like mass behind the stretched and bulging gastrohepatic omentum, depressing the stomach so that the lesser curvature was on a line with the umbilicus and the greater curvature at the pubes (Fig. 117). Drawing up the stomach, omentum, and transverse

colon, an opening was found in the transverse mesocolon, some 4 inches in diameter, and, as in the previous case, at the point where the mesocolon is usually opened in a posterior gastro-enterostomy, that is, in the avascular portion in front of the ligament of Trietz (Fig. 116). Through this opening about 5 feet of the jejunum

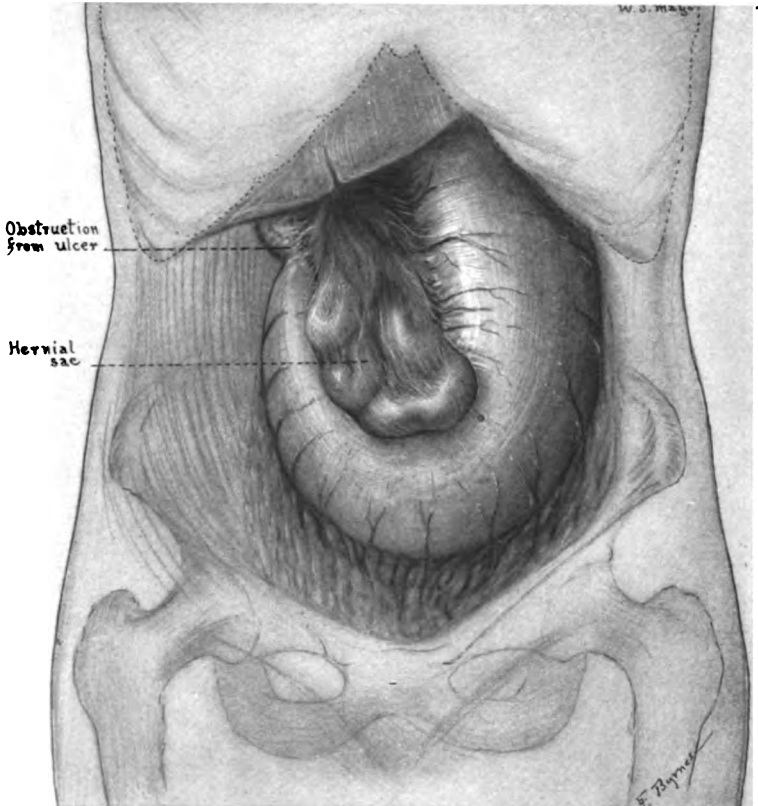


Fig. 117.— Shows the hernial protrusion in Case II, as it appeared above and in front of the stomach.

had entered, passed behind the stomach, carrying the peritoneum of the transverse mesocolon ahead as a sac, the firm ring of which was at the loop of the middle colic artery. The sac passed behind the stomach, pressing upon and pushing forward the gastrohepatic omentum as an outer sac. These two structures had become fused, obliterating the lesser cavity of the peritoneum at that point,

over an area about the size of a silver dollar. The stomach was prolapsed and dilated, so that it filled almost the entire abdomen and pelvis, and contained three quarts of food and fluids, which were removed during the operation. There was an ulcer of the first portion of the duodenum which had perforated posteriorly and become adherent to the head of the pancreas. The sac was obliterated by linen sutures to the posterior wall of the stomach, and posterior no-loop gastro-enterostomy was performed.

The patient's convalescence was uninterrupted. She gained weight at the rate of a pound a day for the first twenty-two days.

These two cases present features of interest not only on account of their rarity, but also because of the primary pathologic condition, which appears to have been the important factor in the production of the hernias.

Both patients were of the type of build Martin describes as typical of Glénard's disease.* The kidney of each was prolapsed, the uterus low and retroverted, and undoubtedly there was in each case a primary prolapse of the stomach. The duodenal ulcer which existed in both had undergone a chronic perforation, causing dense adhesions and fixing the duodenum beyond the stomach, just as the cardiac end is held normally by the esophagus. Had the ulcer been the usual type of saddle ulcer of the lesser curvature of the stomach, the hernia could not have occurred because of the adhesive obliteration of the upper part of the lesser cavity of the peritoneum. The obstruction in both instances was extreme, the huge stomach sagging down in front of the intestines. The patients were emaciated and dehydrated, and for months had been in the habit of emptying the stomach every twenty-four to forty-eight hours of a great accumulation of undigested and unpassed food products. The abdominal muscles exerted great force in these violent efforts at vomiting, compressing the intestines behind the stomach, which was fixed at each extremity and greatly prolapsed in its middle part. In this way pressure was brought to bear on the transverse mesocolon upward in the line of least resistance, causing this peculiar form of hernia.

* "Surgery, Gynecology, and Obstetrics," Dec., 1908.

DIAPHRAGMATIC HERNIA, WITH REPORT OF THREE CASES *

By E. H. BECKMAN

Diaphragmatic hernias are not so rare as to be a curiosity, but are few enough to be of considerable interest.

In reviewing the literature for 1908, not a single case could be found reported in American medical journals.

Von Bergmann's "Surgery" in regard to hernia of the diaphragm says: "Up to the present time no radical operation has ever been performed for non-strangulated hernia in this region, although an operation is indicated provided the diagnosis is certain."

Diaphragmatic hernias are either congenital or acquired.

Congenital.—The congenital hernia, as a rule, cannot be benefited by operation, because there is an absence of so much of the diaphragm that it is impossible to fill the opening. The diaphragm is derived from five elements—a mesial, two ventrolateral, and two dorsolateral formed much later. When the splanchnopleures meet so as to enclose the foregut, they form a mesial septum between the right and left halves of the coelom, *i. e.*, the gut has both a ventral and a dorsal mesentery. From this mesentery is developed the mesial element of the diaphragm. It is said that the vitelline veins which lie on either side of the foregut become so dilated that they push their covering of splanchnopleure out laterally until it comes in contact with and adheres to the somatopleure, thus forming the ventrolateral parts of the diaphragm. This occurs as early as the third week. The dorsolateral parts of the diaphragm are developed only in mammals and are apparently later structural additions, not occurring until the third month. They grow out as

* Reprinted from "Surgery, Gynecology, and Obstetrics," Aug., 1909.

crenate folds from the dorsum of the body, although the Wolffian ridge, the suprarenal body, and the development of the liver and stomach, all apparently aid in closing up the gap at the dorsal side of the diaphragm. The relatively large size and rapid development of the liver aid in separating the right pleural cavity from the peritoneal cavity, and explain why congenital hernias of the diaphragm occur on the left side so much oftener than on the right. Most authorities give a ratio of eight to one. When the diaphragm is fully developed there may be gaps between the muscular portions covered only by peritoneum and pleura. Two of these are constant, one ventrally between the sternal and costal portions, known as the foramen Morgagni, and one dorsally, between the lumbar and costal portions, known as the foramen Bochdaleki. The congenital hernias are not true hernias in the sense that they have no peritoneal sacs.

Acquired Hernias.—The acquired hernias are more often amenable to surgical treatment. They may be acquired suddenly, as following a stab or gunshot wound, a crushing injury, or from any cause which increases the intra-abdominal pressure, or they may be produced gradually by one of the abdominal organs forcing its way through a weak place in the diaphragm, or through one of the natural openings. The most frequent of the normal openings for the site of a hernia is the opening for the esophagus. Next in frequency are the openings for the splanchnic nerves, and then the one for the aorta. Another form of hernia, described by Thoma, as *eventratio diaphragmatica*, is where the diaphragm is so relaxed that it simply bulges instead of rupturing.

Symptoms and Diagnosis.—The symptoms of diaphragmatic hernia are most commonly those of strangulation of some of the abdominal viscera. In order of frequency, the stomach, the large intestines, and the small intestines are quite commonly found in the thoracic cavity. If abdominal viscera have entered the thorax, their presence can be determined by an increased tympanitic note on percussion, and the sound of intestinal noises on auscultation. The lack of expansion of the lung, and symptoms due to pressure upon the respiratory organs, should not be overlooked. Dextro-

cardia is a valuable sign, and in the absence of other causes for the heart being on the right side, a diaphragmatic hernia should be suspected. Distention of the stomach for the purpose of outlining it will be of service. A radiograph taken after a bismuth-paste meal, or a high enema containing bismuth, may show the stomach or colon, or both, in the thoracic cavity.

Non-strangulated hernias are much more difficult to diagnose. There is pain in the upper part of the abdomen and under the ribs, with colic. There may be persistent dyspepsia, acid eructations of gas and sour fluids, and persistent vomiting. Sometimes blood may be present in the vomitus and in the stools. There are cases in which the symptoms are more or less typical of gastric ulcer. (One of the cases reported in this paper was diagnosed as ulcer.) The stomach analysis may be misleading.

Treatment.—There is no palliative treatment for this condition. Diet and rest may relieve the symptoms temporarily in some of the cases, but the great majority of them succumb to strangulation of some of the abdominal organs sooner or later. According to Lacher, of 36 cases of injury of the diaphragm that were not operated upon immediately, 5 died the first day, 10 within a month, 5 within five years, and 5 within twenty years, the result of strangulation. Berchthold collected 24 cases of injury of the diaphragm that had been operated upon, and found that 22 had recovered and only 2 had died.

There can be no definite method of operation for these cases, because no two are similar. Surgeons differ in regard to the method of approaching the hernia. Some advise doing a thoracotomy first, while others prefer the abdominal route. The chief arguments in favor of opening the thorax are that in some cases it is impossible to reduce the hernia on account of the negative pressure above the diaphragm until the lung has been collapsed, and because the thoracic route gives easier access to the diaphragm for repair. The abdominal route, however, seems the more rational, since a considerable number of hernias can be reduced without opening the thorax, and one does not care to collapse a lung if it can be avoided. The viscera injured from strangulation are the

abdominal organs, which are better cared for through an abdominal incision. In certain cases, however, it is necessary to open both the abdominal and pleural cavities. In some cases the hernial opening can only be closed by suturing the stomach to the edges of the hernial ring.

The very large hernias are almost hopeless, and many of the smaller ones require all the skill and ingenuity of the experienced surgeon to effect a cure.

The following cases were operated upon by Dr. W. J. Mayo, at St. Mary's Hospital, and are reported with his permission.

CASE 1.—C. E. S., aged seventeen years. An American born boy; thin and undersized; weight 110 pounds. When a baby he would often wake up at night and vomit sour undigested food. The parents state that he had no trouble before he was three months old. Since then he has had constant stomach trouble, great distress, and at times vomiting of great quantities of soured, undigested food three or four hours after taking. When there was more fermentation than usual, the patient would be in bed for a few days. For the past year and a half he has used the stomach-tube, often washing up remnants of food taken two days before. He now lives exclusively upon liquids. Bowels are constipated. The stomach is enormously dilated, and at times there is visible peristalsis. There are no breath sounds on the left side of the chest, and no expansion. The heart is in the median line and slightly to the right. Stomach analysis gave a total acidity of 48. Free HCl, 32; combined HCl, 16. No lactic acid or blood. Diagnosis, *congenital diaphragmatic hernia and pyloric stenosis*.

Exploratory operation revealed a congenital absence of the diaphragm and of the lung on the left side. The duodenum, after passing behind the stomach, passed directly into the left chest. There were no intestines in the abdominal cavity except the sigmoid. The hugely dilated stomach filled the abdomen. No operative procedure was attempted.

CASE 2.—J. N., aged forty-seven years. Farmer. Came for examination in December, 1906. A year previously he had a severe diarrhea for three weeks, and dated the beginning of this trouble from that sickness. He passed no blood at this time and felt fairly well following the sickness, although food gave him some discomfort. For the past seven months he has been greatly dis-

tressed after taking food, and has vomited sour food from fifteen minutes to one-half hour after eating. He has eructations of gas and sour liquids. Rich sweet foods disagree with him, but sour foods do not trouble him much. Bread and milk is his best diet. He has not been able to work much all summer, and has lost 16 pounds in weight. Bowels are fairly regular. Occasionally sour liquids are regurgitated at night, which gives him relief. He has a right inguinal hernia. He is thin, and his skin has a glossy appearance, but not dry or cachectic. Stomach analysis showed total acidity of 9. No free HCl. Combined acidity, 5. Much blood and lactic acid. Diagnosis, *ulcer of the stomach*. The patient refused operation, but returned a year later. At this time he feels better than he did a year ago, and has not lost any more in weight. He is weak and has attacks of sour stomach and vomiting, the same as a year ago. He is constipated and has blood in the stools. Sour fluids regurgitate when stooping or lying down. There is a sore spot to the left of the pit of the stomach.

Operation: (1) Herniotomy. (2) Negative exploration of stomach and gall-bladder—a diaphragmatic hernia to the left of the aorta nearly the capacity of the first, with a wide neck into which a portion of the stomach could easily pass. The stomach was sutured with mattress sutures of linen to the edges of the opening in the diaphragm and to the abdominal wall to prevent it from entering the hernial cavity. The patient made a good recovery and has been well since.

CASE 3.—Mrs. R., German; wife of a farmer; aged forty-seven years. Two children. Eight years ago she had some indefinite bladder trouble, from which she recovered and remained well until four years ago, when she was in bed four months with a cough, and pain in the region of the stomach. She gradually began to have attacks of sharp, severe pain in the pit of the stomach and to the left side, one-half hour after meals. She began to vomit when the stomach was full, not vomiting, as a rule, after a single meal unless she ate a great deal. She occasionally vomited dark blood, and food eaten two or three days previously. At night would vomit food eaten at noon. During the last year she has had more severe pain and vomits more; has not been able to keep food in the stomach more than an hour. About a year ago she noticed a tumor the size of a hen's egg under the right costal arch, which she could move about freely. It increased in size. She lost 100 pounds in three years, and was very much emaciated. The heart-beat was intermittent; apex-beat to the right on a level with the end of the ster-

num. There was a small freely movable tumor the size of a lemon under the right costal arch which was not very tender. No enlarged glands could be felt. Stomach analysis: total acidity, 5. No free HCl. Combined acids, 2. Lactic acid present. No blood. At the time of the stomach examination the tube could be passed but a short distance, and on attempting to distend the stomach the patient experienced so much pain that the effort was abandoned. Diagnosis, *cystic gall-bladder*. Stomach to be explored.

Operation: Diaphragmatic hernia in which one could introduce the hand at the site of the esophagus. On opening the abdomen no stomach was to be found. The duodenum on the left side was traced up to the pylorus, which lay high up under the left lobe of the liver just at the diaphragmatic opening. The entire stomach, which was very large, was in the thoracic cavity, and quite adherent inside the cavity next to the heart, but outside the pericardium. Adhesions were loosened up and tied extensively, which, fortunately, could be done, as the patient was very much emaciated. The stomach was sutured by mattress sutures of linen, the dome to the margins of the diaphragmatic opening, the body sutured at various points to the parietal peritoneum, and the pylorus and duodenum were drawn to the right side and held by sutures so that the entire stomach was replaced. Large cystic gall-bladder containing one stone. Cholecystectomy.

The patient did not vomit while in the hospital, and made an uneventful recovery.

RETROPERITONEAL LIPOMA*

By M. S. HENDERSON

Retroperitoneal lipomata appear to be sufficiently rare to warrant recording a case which was under observation in the clinic at St. Mary's Hospital. This case is one of two that have been observed in the Mayo clinic.

Literature on this subject is fairly abundant, but is mostly confined to that written by European surgeons. A detailed, clear, and concise report of two cases is to be found in the "Journal of the American Medical Association" for October 22, 1904, by Dr. George Ben Johnston.

Until the year 1904 there were only about fifty cases on record. In Adami's classification, published in 1896, based upon forty-two cases, they are divided according to their origin into three groups: first, perirenal; second, doubtful; third, mesenteric. It is, however, variously estimated that from one-third to one-half originate in the fatty tissue about the kidneys, the remainder falling into one of the other two groups. Their growth may reach an enormous size. One case is reported in which the tumor weighed 66 pounds and several are reported weighing over 40 pounds.

These cases are essentially benign in their character, as only three of the cases on record showed sarcomatous degeneration, and only one patient who recovered after the removal of the growth required further surgical interference. These growths are a menace to the patient in only two possible ways: primarily, by their large size; and, secondarily, by their tendency to occasional sarcomatous degeneration, the latter condition being of sufficient frequency to alone demand their removal.

* Reprinted from "The Journal of the Minnesota State Medical Association and The Northwestern Lancet," Sept. 1, 1909.

These tumors are composed of fatty tissue, with varying amounts of fibrous and myxomatous tissues, and are therefore designated as *lipoma*, *fibrolipoma*, and *myxofibrolipoma*. They are not encapsulated, and hence are difficult to remove *in toto*.

But few symptoms are produced by such tumors, and they exert their baneful influence upon the individual by mechanical effects due to pressure on neighboring important organs. Usually it is the large size of the tumor which leads the patient to seek relief. A dragging sensation, which does not amount to real pain, is usually complained of. Nausea and vomiting may be present, and the latter may be so persistent as to cause a marked degree of inanition, to be accounted for by the pressure upon, and consequent irritability of, the stomach. Dyspnea, due to pressure upward on the diaphragm, may be present and may be a prominent symptom. The growth of the tumor may even be so extensive as to press on the common duct, causing jaundice and introducing a serious complication, which makes the diagnosis still more difficult. Obstruction of the bowels may supervene. Neuralgia of the legs, due to pressure upon the lumbar plexus, and, in fact, almost any symptom that might be caused by pressure on important organs may be present in the late stages.

In the case at hand, a previous history was given of injury, which is often a prominent factor in the causation of lipomata elsewhere in the body, and is of interest on that account.

A diagnosis of these growths is difficult, and they are ordinarily mistaken for various other conditions. Probably the most frequent error has been to mistake them for ovarian tumors. This can be explained by the fact that the growths closely simulate the fluctuation of a cystadenoma of the ovary. This evidence has been so positive to some surgeons that even after a dry puncture an exploration was necessary to convince them of the error of their diagnosis.

These cases are also often confounded with retroperitoneal sarcomata, but the latter condition grows more rapidly, and cachexia is, as a rule, a more marked symptom.

From the fact that this condition has been variously mistaken for

hydronephrosis, distended gall-bladder, pancreatitis, and mesenteric cysts, it will be seen that a differential diagnosis is difficult, often impossible, and the condition is one which exploration alone will clear up.

The treatment is necessarily surgical. Various methods of approach are advocated for the removal of the growth. Some surgeons recommend a lateral incision in the flank, but here the exposure is not the best, and the anterior median is mostly preferred. Others advocate the slipping back of the peritoneum, but this is more often impossible, owing to firm and extensive adhesions. With the anterior median incision, opening of the peritoneal cavity, and packing off the intestines, a clear field is obtained, and the extent of the tumor can be accurately determined.

The removal of these large tumors is often complicated, and resection of the intestine may be necessary, due to the fact that the mesenteric blood-vessels are frequently injured in the separation of adhesions, and the area of intestine thus deprived of its nutrition must be removed at once, or gangrene will supervene. The tumor is frequently adherent to the vena cava, and much care has to be exercised not to injure this vessel. Nephrectomy may be necessary in those cases of perirenal origin where the kidney is so embedded in the substance of the tumor as to make freeing it impossible.

REPORT OF CASE.—E. V., widow, aged fifty-nine; nativity, Switzerland. Presented for examination on June 11, 1909.

Family history, negative. Had five children, the oldest thirty-five, the youngest thirty. Menopause at fifty and no flowing since. Twenty years before she had quite a severe fall, and since that time has been subject to a good deal of backache. For three years she has been troubled with frequent micturition, having to arise to urinate two to three times every night and as often as every half-hour during the day. Increasing and marked constipation, with occasional quite sharp, cramp-like abdominal pains, had been frequent. At no time has she passed any blood or mucus per rectum, neither has she noticed any blood in the urine.

For the past eight months she had noticed that her abdomen was growing considerably larger. Three months previously she

had consulted her family physician and had been told that she had a "floating tumor," which should be removed. During these eight months she lost 20 pounds, and for the last year had been "spitting" up her food and fluids, and had observed that this was particularly prone to occur if she was lying on her right side.

Physical examination showed a well-nourished woman in spite of the loss of 20 pounds. The apex-beat was displaced upward to the nipple line. Gurgling and splashing were to be heard over the stomach area. A large, indefinite, semifluctuating mass was to be felt in the abdomen, the exact origin of which was not determined. It seemed more prominent on the right side than on the left, and extended from the right costal arch to the pelvis. Bimanual examination of the pelvis was negative. Urinary examination gave specific gravity of 1020, alkaline. No albumin; no sugar. Blood normal.

A tentative diagnosis of ovarian tumor was made, and exploration advised and accepted.

Operation, June 15, 1909, by Dr. W. J. Mayo. The abdomen was opened through a median incision. All of the intestines, including the transverse colon, were found down in the pelvis, while the stomach and liver were crowded up against the diaphragm. The mass was seen to be retroperitoneal, presenting largely through the gastrocolic omentum, making a tumor a little larger than a full-term pregnancy. Fat lobules showed clearly through the peritoneum, and it could be made out that the tumor had its origin in the left kidney region, extending through the mesentery well across into the right side.

The posterior layer of peritoneum was incised, and the tumor seen to be non-encapsulated. It was carefully shelled out, the greater part coming out in bulk, but much of it being taken out piecemeal. The kidney was not molested, as it was not densely adherent to the growth. Comparatively little bleeding was encountered, and that was controlled by clamps and afterward by ligation. The posterior layer of peritoneum was then drawn together and the median incision closed in the usual manner. No drainage was provided. The tumor weighed $19\frac{1}{4}$ pounds. Recovery was uneventful, the patient returning to her home in three weeks.

GENITO-URINARY ORGANS

TRANSPERITONEAL REMOVAL OF TUMORS OF THE BLADDER *

By CHARLES H. MAYO

General application of modern methods in the examination of diseases of the bladder has been of great value in making early diagnoses of tumors of this viscus.

With the aid of the cystoscope, portions of growths are removed by snares, forceps, or by curets, and then washed from the bladder for examination. The result of the microscopic examination, when considered with the location and extent of the tumor as shown by the cystoscope, enables the operator to choose a method which will offer the greatest possibility of cure to the patient.

Cystoscopic examinations should be made by means of fluid distention of the bladder, as small pedunculated papillomata will float out in the liquid when they might cling to the mucosa in air-distention and thus be overlooked.

In the natural evolution of the surgery of this region, which is still far from being crystallized, many changes from former methods of treating diseases and their complications have become necessary.

When we consider Watson's statement that operations in 28.6 per cent. of benign and 46 per cent. of carcinomatous growths of the bladder have been surgical failures, we can see the necessity for early diagnosis, and the choice of a method of approach so that radical operations may be the rule and not the exception.

The ordinary routes of attack have been the suprapubic, infrapubic, urethral, vaginal, or perineal.

The operative technic, as made through the urethra, will naturally be chosen by those who become expert in the use of the cysto-

* Reprinted from "Annals of Surgery," July, 1908.

scope, but we believe that very few tumors will be eradicated by this route, and that it is not the best method for the general surgeon. Watson shows that for an apparently simple procedure it is accompanied by a rather high mortality.

Of the other methods, the suprapubic is the most commonly employed. Through various abdominal incisions the bladder is opened in the Retzius space, great care being exercised to preserve the peritoneum intact. By this route papillomata have been removed with 20 per cent. mortality, carcinoma with 28 per cent., and sarcoma with 63 per cent., with early recurrence in over 20 per cent. of cases either benign or malignant, as given by Watson, who has collected a large series of operations, the work of many surgeons.*

Considered from an operative standpoint, we must recognize the fact that surgical failures are common in all kinds of tumors of the bladder above the prostate. Owing to the great tendency to recurrence as well as the possibility of a change in the character of benign growths, they must all receive radical treatment. Therefore, it is not my purpose in these remarks to devote time to the various tumors of the bladder from a pathologic point of view, nor to those advanced cases which require the complete removal of the viscus. In this connection we desire to call attention to the fact that the lymphatics of the bladder are few and inactive, which fact delays metastasis of malignant tumors, rendering them for a considerable period a local disease. Carcinoma confined to the bladder may be looked upon as curable by operation.

Clinically there occur: first, tumors with a pedicle; second, those with a broad base of attachment to the mucosa; third, those which involve the whole thickness of the bladder-wall.

The latter variety may by continuity of tissue involve other organs—the prostate, ureter, urethra, or adjacent abdominal structures. Very large areas of the bladder, two-thirds or more, can be resected, and the remainder will regenerate and dilate to a considerable extent, often forming a very serviceable organ, as pointed out by Harris.†

* "Annals of Surgery," Dec., 1905.

† *Ibid.*, Oct., 1902.

In an effort to develop an operation which would render all parts of the bladder accessible, the transperitoneal method seemed to be the most favorable. Watson* has considered the removal of the unopened bladder through such an incision. F. Harrington† has reported a case of chronic disease of the bladder treated by the transperitoneal incision. As a rule, when used at all, the method has been one developed without previous plan, due to necessity or accident at the time of operation.

We have not been satisfied with the ordinary suprapubic incision in operating upon large tumors of the bladder. While several cases did exceedingly well, in two instances of cancer we not only failed to cure the local condition, but unfortunately transplanted the disease to the abdominal wall and space of Retzius.

The usual result of imperfectly removed cancer is not only that relief is temporary, but the growth of the recurring tumor is usually more rapid and the condition of the patient, if anything, is worse than before the operation.

After securing the most favorable general and local conditions possible, the bladder being cleansed and emptied, an operation is made after the following method:

Operation: The patient is placed in the high Trendelenburg position and a median incision made from the pubes upward for 6 inches or more. The pelvis is well packed with gauze pads which hold the intestines in the upper abdomen. The abdominal incision is also protected by gauze pads. The bladder is caught by two tenaculum forceps, lifted into the wound, and opened by a 2-inch median incision. The small amount of fluid in the bladder is absorbed with gauze and the incision is enlarged upward and downward until it is ample for the purpose. The tumors may be cut from the bladder with scissors and the denuded area burned with cautery.

Malignant growths involving the lower half of the bladder can be raised with tenaculum forceps and resected with a Paquelin cautery. The area removed should include healthy mucosa sur-

* "Annals of Surgery," Dec., 1905.

† *Ibid.*, 1893.

rounding the tumor. No sutures are required to close these areas, the space being allowed to cicatrize.

When malignant growth necessitates the removal of a great part of the bladder, it is divided and removed freely, whether covered by peritoneum or not. In making the incision, $\frac{1}{3}$ to $\frac{1}{2}$ inch of tissue about the urethral entrance should be preserved if possible. If the bladder be involved at the ureteral opening, after the diseased portion of that viscus is removed, it is divided near the bladder and drawn into the abdomen through a perforation in the peritoneum close to the remaining half of the bladder, into which it is passed and where it is attached with catgut sutures. The peritoneum is closed over the exposed ureter in a fold by a few sutures, a method which insures rapid healing. The remaining portion of the bladder is now closed, often forming a greatly reduced but serviceable viscus.

The bladder wound, regardless of its size, is closed by a through-and-through continuous suture of catgut introduced in the original Connell method. This stitch is a running mattress suture and is passed through the entire thickness of the bladder-wall, all loops pulling from the mucous side, and when drawn close, making a complete air-tight and water-tight continuous mattress stitch. The line of suture is now protected by a suture of silk, or preferably linen, applied as a Cushing parallel peritoneal suture, taking a square bite of the peritoneum, first on one side, then on the other, of the line of closure, the needle being inserted parallel with the incision. This suture approximates the peritoneum and protects the primary suture just as when it is employed in gastrojejunostomy, and is used for the closure of all the bladder incisions and resections regardless of the amount removed.

Should the bladder incision pass forward of the peritoneal fold, the closure will be the same, and is accomplished by drawing the bladder toward the abdomen and carrying the peritoneal fold to a lower level; the advantage of securing early peritoneal adhesions being developed to the fullest extent. As a rule, the abdominal wound is closed without drainage, but should the general cavity of the peritoneum become soiled, a temporary drain could be made

through a stab-wound. The bladder is catheterized at regular intervals for the first few days following the operation, if it is necessary, but, as a rule, the patients void their urine at frequent intervals with little distress.

We have, in five instances, operated upon large papillomata of the bladder by the transperitoneal route, without mortality. Three

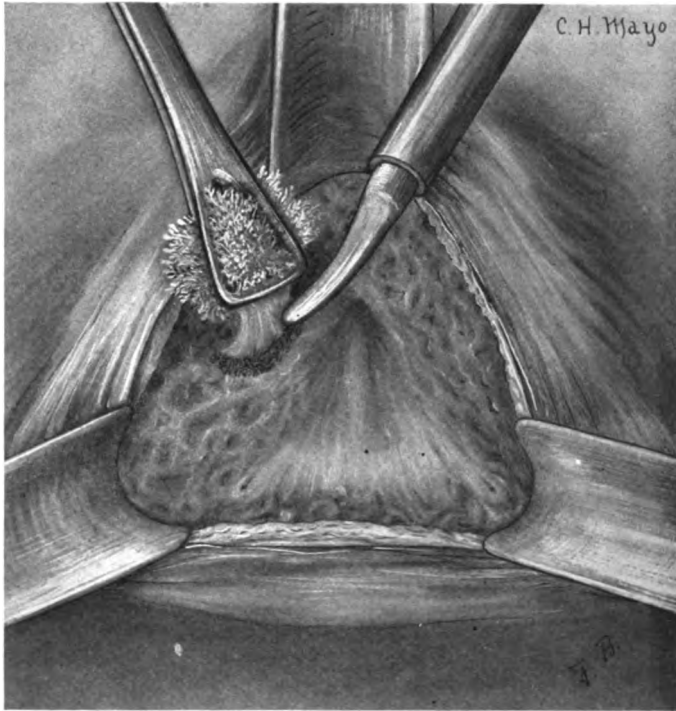


Fig. 118.—Cautery resection of papilloma of bladder.

of these tumors were carcinomatous, the others benign. A brief report of these cases is appended.

CASE I.—Male, twenty-seven. Ten years with bladder symptoms and more or less blood in the urine. Large sessile base. Carcinoma left side of bladder. Operation, 3-27-'07. Transperitoneal resection of over one-half of the bladder with transplanting

of left ureter into the right half of the bladder. Bladder drained by perineal incision. Voluntary urination with control of bladder after first three or four hours. In the fourth week all drains closed.

CASE II.—Female, thirty-nine. Duration of symptoms two

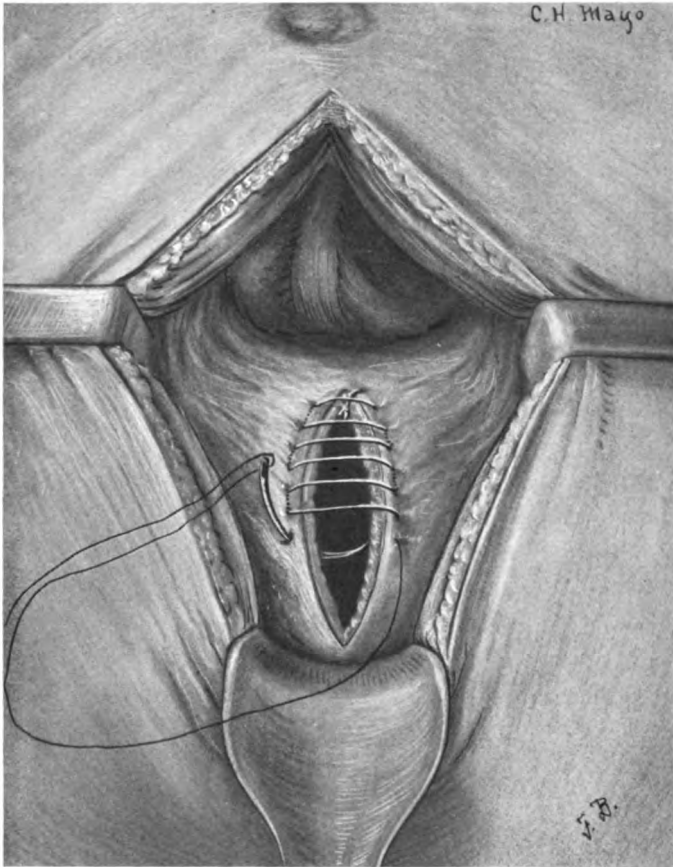


Fig. 119.—Showing method of closure of bladder incision.

years. Blood in urine one year with much local pain. Cystoscope disclosed three tumors of lateral bladder wall, two small and one as large as a lemon. Operation, 5-1-'07. Transperitoneal with cautery resection of malignant papillomata. Bladder incision

closed. Urine voluntary. Case well at examination after ten months.

CASE III.—Male, fifty. Duration of symptoms sixteen months.

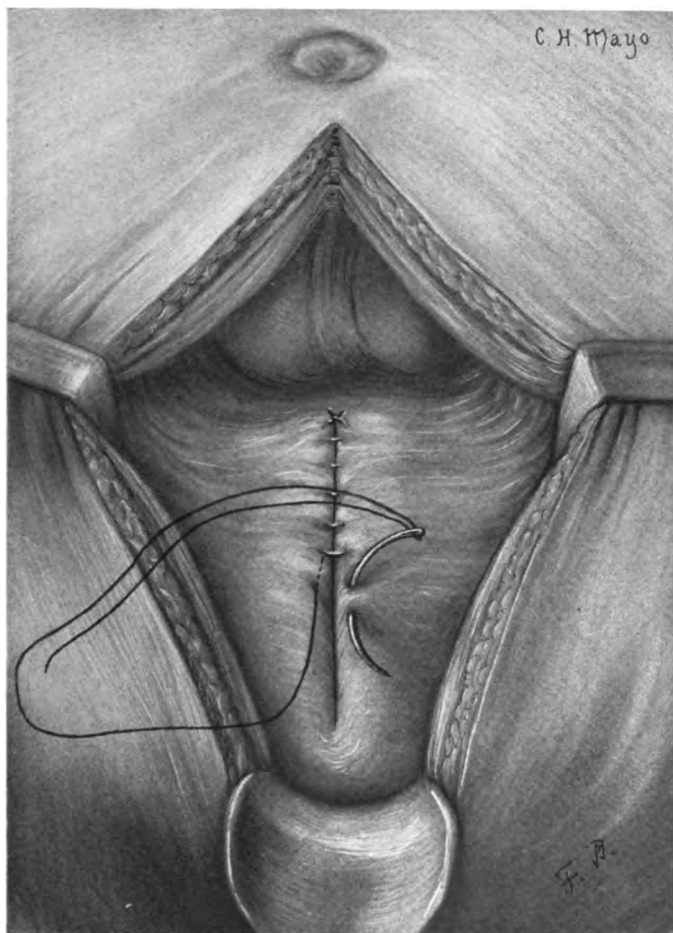


Fig. 120.—Cushing peritoneal suture closing bladder wound.

Blood in urine almost constant. Papilloma size of small orange. Benign. Operation, 6-14-'07. Transperitoneal, and excision with cautery. Bladder incision closed without drainage.

CASE IV.—Male, forty-nine. Slight symptoms two years.

Blood in urine three months. Operation, 12-7-'07. Transperitoneal removal of sessile carcinoma size of walnut near base over left lobe of prostate. Four inches bladder resected with cautery.



Fig. 121. Removal of large amount of bladder with transplantation of ureter.

Prostate removed through same incision. Suprapubic drain. Voluntary urination with healed drains in three weeks.

CASE V.—Male, fifty-four. Duration of symptoms two years. Blood in urine one year. Tumor, right wall, size of walnut. Operation, 1 8 '08. Transperitoneal resection, cautery.

TUMORS OF THE BREAST, WITH SPECIAL REFERENCE TO OBTAINING BETTER RESULTS IN MALIGNANT CASES *

By E. S. JUDD

Precancerous predispositions exist in the majority of cases of tumors of the breast, the cure of which prevents the development of cancer. We have the best evidence of this precancerous stage in fibroadenoma of the breast, chronic mastitis, cysts, and other benign conditions.

Eighty-five per cent. of all tumors in a woman's breast are malignant to begin with, and it is estimated by the best authorities that one-half of the remaining 15 per cent. will become malignant if the patient lives long enough. We are frequently confronted with a patient having a history of a small simple tumor for many years which suddenly began to grow until now there is no question as to its malignancy. Some authorities contend that this tumor was malignant from the beginning, but the most reasonable contention is that the early tumor was benign and that it existed all the time as a precancerous irritation.

Until the advent of modern surgical methods we, as general practitioners, advised the patient with an apparent benign tumor to put off operation until evidence of malignancy appeared, and in so doing we not only accepted more responsibility than we would have incurred in operating, but we kept a great many cases under our care and watching until too late to accomplish a cure even with most radical procedures. In other words: one-half of the cases which come to operation too late, come late because they are being watched by their home doctor. In waiting to prove our diagnosis by re-

* Reprinted from "The St. Paul Medical Journal," October, 1909.

traction of the nipple, skin attachment, and glandular involvement, we make it impossible to cure over 25 per cent. of the patients, while if we operate during the first stage of the condition we may cure all of the simple cases and approximately 85 per cent. of the malignant.

Tumor in any region should no longer be considered a medicinal condition. Local applications will accomplish nothing in the presence of a real tumor, nor is it safe to depend on aspiration, for should we find a cyst full of clear fluid we may, and frequently do, have a beginning papillary carcinoma in some part of the inside of the cyst sac.

We should bear in mind that cancer is originally an absolutely local disease. In the later stages we find it penetrating into the lymphatic glands and organs at some distance from the original focus, but in the beginning there is just a small point of infection. In a great many instances from the history and physical examination we are able to say that the tumor is malignant, but we can never state positively that it is *not* malignant. Any tumor, no matter how small, which shows the slightest skin attachment may be malignant.

In sending a specimen to the pathologist, always remove the entire tumor. Incomplete removal of any malignant growth is apt to allow implantation of cells. Having removed the doubtful tumor we are often able to clear up the diagnosis reasonably well by the microscopic appearance, although no tumor should be allowed to go without a pathologist's report. In doubtful cases it has been our custom to excise the tumor and send it at once to the laboratory, where frozen sections are made and the report sent back in from two to five minutes. If it is malignant, we pack the tumor cavity with a sponge saturated with Harrington's solution, and do the radical operation at once. In this way the patient has only the one anesthetic and no time is allowed for the grafting of carcinoma cells. In case the pathologist reports a benign tumor, a few subcuticular catgut stitches will close the small wound, and the patient will be allowed to leave the hospital immediately upon recovering from the anesthetic.

We have found this technic very satisfactory and reliable, and

never once during the several hundred frozen section examinations has the pathologist been mistaken, although it frequently requires the examination of several separate sections before he is willing to make his report. We believe that in time we will be able to tell as much, if not more, from a properly stained frozen section a few minutes after the removal of the specimen, as from the same tissue after it has gone through several days of the hardening processes.

In case a frozen section method is not available, in doubtful cases it would be best to remove the entire tumor and put in a few loose stitches without tying. Pack the cavity with a gauze sponge saturated in Harrington's solution or a similar mild caustic, and await the decision until a report can be gotten from a reliable laboratory. If the tumor is reported benign, remove the pack and tie the stitches; if malignant, do the radical operation as soon as possible.

In the present advanced state of medical science, there exists but a single curative measure for any type of tumor of the breast, and that is—the *operative destruction of the local focus*. No matter how young the patient is, or how simple the growth may appear, we recommend that all tumors of the female breast be removed. In no instance are we justified in waiting and watching developments.

In following the plan of early removal, we will undoubtedly operate upon many lesions that are absolutely benign at the time of operation. On the other hand, we will occasionally find that a neoplasm which we supposed to be benign is malignant. Therefore, by doing the radical operation in the early stage of the condition, we can promise the patient a definite cure. In our practice during the year 1908, we found on removal and frozen section that in three instances the supposedly benign tumors in comparatively young women were in reality early malignant disease, and by doing a radical operation in the early stages their chances for permanent cure were enhanced.

The most important factor in determining the prognosis in the malignant cases is the length of time that the tumor has been growing. Knowing that over three-fourths of these lesions are

malignant in the beginning, and that at least one-half of the remainder will become so, we believe that the tumor cannot be removed too soon. The second most important factor in the prognosis, is the extent of the involvement. Along the lines of present-day practice, implication of the lymphatics no longer militates against a cure. The radical operation performed before the pathologist can demonstrate any involvement of the glands will give about 85 per cent. of cures, although as soon as we are able to show that one axillary lymph-node is involved, the percentage of cures drops at once to 25 per cent., and if the secondary lymphatics (supraclavicular) are involved, we will be able to effect very few, if any, cures.

The age of the patient is of much importance because of the great activity of the lymphatics in the young. We have found but one case of cancer of the breast in a woman under thirty years of age that has remained well over three years since operation. This case was reported by Warren, and was operated upon within a few weeks from the time of discovery. We can promise more hope to a woman of sixty who has had cancer for a year, than to a woman of thirty who has had one for only three months.

In several instances we have operated on malignant tumor in a lactating breast both before and after confinement, but have never been able to effect a cure, owing, no doubt, to the great activity of the lymphatics at this time.

In approximately 90 per cent. of these cases the lymphatics to show involvement first are the axillary. Poirier and Cunéo have recently shown that one lymphatic vessel passes directly from the upper border of the breast to the supraclavicular glands, although we have never seen this group of glands primarily involved.

The attachment of the breast to the chest-wall means involvement of the third and fourth group of glands. The lymphatic vessel leading to these glands passes through the pectoral muscles and into the fourth intercostal space and drains into the mediastinal glands. It is through this chain of lymphatics that we find, in advanced cases, evidences of spinal involvement. This shows how useless it would be to attempt a cure in a case in which the tumor

is fixed to the chest-wall, as the fixation means that the inaccessible mediastinal glands are involved. We may be able to make some of these patients with extensive trouble more comfortable by removing a large, foul, ulcerating breast, but we cannot cure them.

The lymphatics in the skin surface of the gland may be divided into two groups. The vessels over the periphery of the gland communicate with the same vessels of the opposite breast, and it is through these that the second breast will sometimes become diseased.

The central set of cutaneous vessels forms a network around the nipple and areola, and from this the vessels pass inward to unite with the principal lymphatic channels which empty into the glands in the axilla. The lymphatics in the fascia of this region drain principally toward the axilla, though some recent investigators are endeavoring to prove that it is through the fascial lymphatics that the liver frequently becomes involved.

An early operation can be performed by a competent surgeon without danger to life and without pain or any notable disturbance of function. The very radical and extensive operation in which the clavicle is resected and all the supraclavicular glands are removed, or in which a part of the ribs and pleura are excised, carries a high mortality, with but slight chances of accomplishing a cure. The early radical operation with removal of all the axillary fat and glands may be accomplished with practically no mortality.

Not many years ago it was the custom to encourage a long convalescence in these cases by binding the arm in a painful position and strapping it to the chest with plaster-of-Paris. We have learned since then that convalescence is much more rapid and attended with but little suffering if the wound is dressed simply with a snug-fitting gauze dressing, allowing and encouraging the free use of the arm. It is our practice to allow patients to be out of bed as soon as they wish, as they are apt to be more comfortable in an easy chair than they are lying in bed.

The pectoralis major muscles are anatomically divided into two parts, each of which has its separate blood- and nerve-supply. By saving the upper part, which is usually about one-third of the mus-

cle, we in no way jeopardize our exposure to the axilla, and at the same time we get a much earlier and more complete restoration of the normal motions of the arm. We have not been able to clear out the axilla satisfactorily without a complete removal of the pectoralis minor, but we notice very little difference in the usefulness of the arm, whether it is removed or not. We are always careful to preserve the long respiratory nerve of Bell and the posterior long thoracic, so as not to interfere with the serratus magnus and latissimus dorsi muscles.

In most instances our patients are able to comb their own hair at the end of the first week after operation. Occasionally, we see considerable swelling of the arm; this may appear soon, or it may appear as late as the year following operation. We believe it is usually due to the thorough removal of the lymphatics, which interferes with the lymphatic drainage of the arm, rather than to pressure upon the vein. Persistent massage and use of the arm will overcome this swelling to a marked degree.

The point I wish most to emphasize in this paper is that the surgeon can promise a definite cure in the majority of cases where the patients present themselves for treatment on the appearance of the first symptoms. As our technic develops, and we have a better knowledge of the extension of the growth of the tumor, we are able to cure a larger percentage of the advanced cases. We are, therefore, forced to believe that an early operation, even though badly done, will effect more cures than will a perfect operation which is performed late. Furthermore, in order to get malignant cases early, we must necessarily remove all tumors as soon as they are discovered, as many of the doubtful and some of the supposedly benign cases will eventually prove to be malignant.

TUMORS OF THE BLADDER *

By E. S. JUDD

An accurate knowledge concerning primary tumors of the bladder during life has only become possible since the invention and the development of the use of the cystoscope.

Vesical tumors are divided into two classes: *benign* and *malignant*. However, the most common type of tumor, papilloma, which was classed originally as a definitely benign tumor, has shown its ability to recur and to cause death by recurrence, therefore finally developing the characteristics of malignancy.

General Consideration and Classification.—About one-fourth of one per cent. of all tumors occur in the bladder, and they occupy 3.9 per cent. of all genito-urinary cases. Males are affected almost three times as often as females, and the disease is most prevalent during middle life.

The most practical and accepted classification of these tumors is that made by Küster and modified by Davis. It is as follows:

- | | |
|------------------------------|--|
| 1. Epithelial Group..... | { Papilloma
Carcinoma
Adenoma
Cysts (dermoid) |
| 2. Connective Tissue Group.. | { Sarcoma
Myxoma
Fibroma
Angioma |
| 3. Muscular Group..... | Myoma |

The most frequent and also the most important tumors of the mucosa and submucosa are the papillomata. These tumors are composed of a branching connective-tissue center, with a fine

* Reprinted from "The Journal of the Minnesota State Medical Association and The Northwestern Lancet," Dec. 1, 1909.

network of vessels, and every portion covered by an epithelial layer. They have a marked resemblance to the vegetable cauliflower. Most of them have a distinct small pedicle, though occasionally a great number of small papillomata are attached together to the mucous membrane of the bladder.

In our series of 56 operated cases, 42 were of the papilloma type. This type of tumor is prone to recur, though the recurrence is not likely to appear at the site of the primary growth if it has been thoroughly removed.

In cancer of the bladder there is very frequently a formation of papillæ which are scarcely to be distinguished from those of papilloma, but careful examination will disclose a characteristic infiltration of a papillary cancer.

Scirrhus carcinoma of the bladder is not common. We have seen but two such cases. The adenoma type of tumor may occur in any portion of the bladder, and it is made up of branching tubules with a single layer of cylindrical epithelium. It is usually flat or nodular in form. No cases of this variety have come under our observation. Although dermoids are occasionally seen, cysts of the bladder are very rare.

Sarcoma and myxoma occur occasionally in children, though these types of the disease are not frequent. There were none of the fibromata in our series. We have seen one of the angioma type. This was in a child five years old—a large angioma presenting in the rectum and the base of the bladder. Myoma springing from the muscular layer may develop into the bladder, and outward into the peritoneal cavity.

Most tumors of the bladder are located in the base of the organ, in the vicinity of the ureteral orifices or near the orifice of the urethra.

Papilloma occurred 42 times, carcinoma 13 times, and angioma once. We have not observed any transformation of the cells in the recurring cases, although in three instances tumors removed through a suprapubic incision occasioned a rapid recurrence in the abdominal wall. The nature of the growth was identical with that of the removed tumor.

Etiology.—But little is known as to the etiology of tumors of the bladder. Areas of degeneration of mucosa showing granulating surfaces will often be seen in cases of marked cystitis, and in several instances we have observed a thickened, red, localized area in the bladder wall, caused by an inflammation or a pressure from outside of the bladder, but we have never known a “true” papilloma to develop in these cases. Repeated irritation, as from calculi, will not produce these tumors, and in our observation of cases, the tumor has never been associated with the stone, except the deposits of salts and incrustations that frequently occur in papilloma.

Symptoms.—The early and characteristic symptom of tumors of the bladder is painless hematuria. This was observed to be the first symptom in more than half of our cases. Bleeding may occur at intervals; the urine appearing clear for weeks or months at a time. Frequency and burning are usually associated with the bleeding, which is likely to increase in frequency until there is constant loss of blood. This was demonstrated by a hemoglobin estimation of less than 25 per cent. in several of our cases.

In view of the fact that so much depends upon getting these cases early for operation, it would appear to be the duty of general practitioners to follow every case of painless hematuria, and not to allow it to go on while awaiting developments.

All of the urine passed may be bloody, and again it may show blood only during the last few drops. The blood may disappear after a single micturition or it may be present for weeks. As long as the blood is thin and does not clot, there will be very little pain. If the tumor lies close to the urethral orifice, partially obstructing the urethra, pain and obstruction will be an early symptom. A carcinoma involving the bladder-wall is more apt to produce pain than the papilloma which is suspended on a pedicle.

Oftentimes, pieces of a papilloma will be passed, and a spontaneous cure has been known to result in a case of a small pedicled tumor, which passed entirely away.

If these various conditions are allowed to proceed without treatment, most of the patients who survive the loss of blood will eventu-

ally succumb with uremic complications, and if cystitis develops the suffering will become intense.

Diagnosis.—Diagnosis of tumors of the bladder can be made by the cystoscope alone. With the aid of this instrument we can determine accurately, the appearance, location, size, and number of tumors; their mobility, attachment, and the extent of involvement, and we can in almost every instance snip off a piece of the tumor large enough for diagnostic purposes, though this is sometimes difficult on account of the extreme tenderness of the urethra, and a very profuse bleeding. In making a routine examination of the urine in all cases we will sometimes find blood that has not been apparent and that cannot be accounted for by other conditions, but if we cystoscope these cases we will occasionally discover a small tumor which can easily be excised at once.

Prognosis.—Watson has studied the records of 653 cases of vesical tumors, 243 benign and 410 malignant, and has found that following more or less radical operations for papillomata and myomata, 34 per cent. were free from recurrence at the end of a year. He states that if the operative deaths and the rapid recurrences are combined under the head of operative failures, such failures will have occurred in 28.6 per cent. of benign tumors and 46 per cent. of carcinomata.

If let alone, benign tumors may cause death by extension, repeated hemorrhages, or from pyelonephritis following cystitis. In many instances if the growth is thoroughly removed, the patient will recover and remain well.

The prognosis in cases of carcinoma of the bladder is as favorable as in carcinoma of other regions, as the lymphatics in this locality are slow to become involved. There can be no question as to the advisability of removing these tumors if we get them early. But should the growth be so extensive that we are unable to remove it thoroughly, we will accomplish little or nothing by interference.

Treatment.—Small pedunculated tumors may often be removed through the urethra with the operating cystoscope, providing one is skilled in the use of the instrument. This apparently simple method will be attended with some mortality, and should not be

attempted for growths of any size. An incomplete removal would hasten their growth, while a radical removal might effect a cure.

Until recently it was supposedly inadvisable to remove any tumor of the bladder that was not suspended, but there is no good reason for believing that an early radical operation will not be quite as satisfactory in these cases as it would be for growth in some other organ. It is seldom satisfactory to attack these growths through a perineal incision, and this route has been practically discarded by surgeons.

If the neoplasm is in one of the upper quadrants near the dome of the viscus, dissecting the peritoneum intact from its posterior surface, the suprapubic incision exposing the bladder through the space of Retzius, gives a very good exposure.

In case the tumor has its attachment at or near the base, it is necessary, in order to do a technical and radical operation, to open the peritoneum first and pack off the intestines and omentum as in resection of other organs, and then open the bladder through its peritoneal surface. It was not until we learned that the bladder had been accidentally opened without serious consequences to the peritoneum during abdominal operations, that we felt justified in deliberately approaching these tumors in that way. We have now removed tumors through a transperitoneal incision in nearly twenty cases, and in none of them have we seen the slightest soiling of the peritoneum. In four cases we have removed the quadrant of the bladder containing one or the other of the ureteral orifices, and have transplanted the ureter to another section of the bladder.

From the statistics given us by Watson, and from the histories of our own cases, we are led to believe that it is always advisable to remove a section of all coats of the bladder-wall.

The incision into the bladder is closed in a manner similar to that employed in closing the stomach or intestine after a resection. All of the coats are turned in and the peritoneal surfaces approximated. No leakage occurred in any of our cases where the incision was made through the peritoneum, while some of the suprapubic cases developed temporary sinuses. The rapid and firm

healing of the peritoneum probably accounts for the better results obtained with the former method.

It will not be necessary to establish drainage unless the prostate or urethra has been interfered with. In our experience patients have done better without a permanent catheter. Many of them will void their urine from the beginning, though some of them will require catheterizing for the first twenty-four hours at intervals of every two hours until they are rid of the clots of blood.

On account of the high mortality, unsatisfactory existence to the individual, and results generally following complete removal of the bladder, we feel that it is seldom, if ever, advisable to recommend this radical procedure.

The advance and the progress in surgery in this field appear to lie in an early cystoscopic examination and diagnosis in all cases presenting blood in the urine, and not in the very extensive operations done in the advanced cases.

THE TRANSPERITONEAL OPERATION FOR REMOVAL OF BLADDER NEOPLASMS *

By E. S. JUDD

The first case of intraperitoneal cystotomy was reported by Dr. Francis B. Harrington † in 1893. In this instance the operation was performed for ulcerative cystitis.

At this time cystotomy by any route was undertaken only in cases of extreme gravity. The mortality from suprapubic operations, operations through the perineum or urethra, was not low; therefore this apparently more serious procedure was not adopted by any great number of operators, and nothing more appeared in the literature concerning it until about a year ago, when Dr. C. H. Mayo ‡ reported five cases of transperitoneal removal of tumors of the bladder which were operated on in St. Mary's Hospital. A few months later Drs. Charles Scudder and Lincoln Davis § reported four cases in which bladder tumors were removed through an intraperitoneal cystotomy.

One of the greatest difficulties with which earlier workers with lesions of the bladder had to contend was the diagnosis. This obstacle, however, was overcome more than twenty years ago by the invention of the cystoscope, and now in nearly every case a pathologic diagnosis can be made by first removing a specimen of the tumor with the cystoscope. By the aid of this instrument we

* Read in the Section on Surgery of the American Medical Association, at the sixtieth annual session, held at Atlantic City, June, 1909. (Reprinted from "The Journal of the American Medical Association," Dec. 25, 1909.)

† Harrington. F. B.: "The Feasibility of Intraperitoneal Cystotomy with Report of a Case," "Ann. Surg.," 1893, xviii, 408.

‡ Mayo, C. H.: "Transperitoneal Removal of Tumors of the Bladder," "Ann. Surg.," July, 1908.

§ Scudder and Davis: "Ann. Surg.," December, 1908.

not only learn the exact nature of the tumor, but we also learn its exact location and extent within the bladder.

Up to the present time the majority of reported cases of tumors of the bladder, as regards both operative mortality and early recurrences, have been very discouraging, and some surgeons prefer not to operate in these cases except to relieve temporarily the symptoms of extreme pain or hemorrhage.

In December, 1905, Dr. Francis S. Watson* published a study of 653 cases. Combining operative deaths and recurrences under one

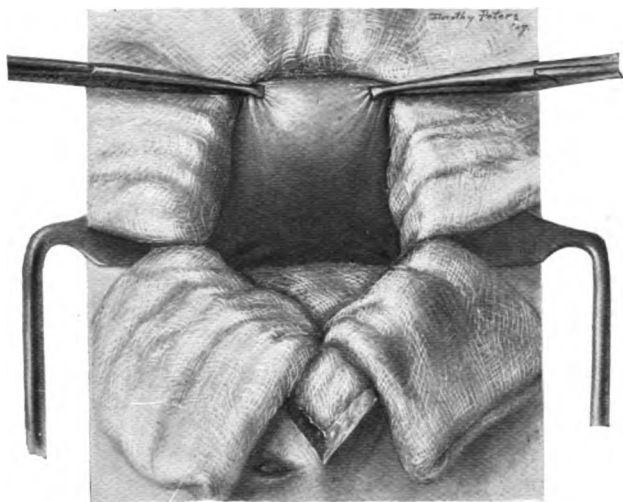


Fig. 122.—Bladder held up into abdominal wound which is spread open with Simpson retractors. Intestines, omentum, and abdominal wound thoroughly protected with gauze pads.

heading, he found that failures occurred in 28.6 per cent. in benign cases and 46 per cent. in cases of carcinoma.

Delay in the diagnosis exposes the patient to the danger of an inoperable condition. Dr. Hugh Cabot† places the responsibility of such delay on the general practitioner who usually sees the patient first. He warns the practitioner against ever allowing a painless hematuria, which in the majority of instances is the first symptom, to go on while awaiting developments, because it is gen-

* Watson, F. S.: "Ann. Surg.," Dec., 1905.

† Cabot: "New York Med. Jour.," June, 1907.

erally admitted that every papilloma, if not malignant in the beginning, will in time become malignant.

The greater bulk of tumors of the bladder with which we have to deal is made up of the papilloma and carcinoma types. Occasionally a myoma, myxoma, adenoma, or angioma is seen, and not infrequently we see sarcoma in children.

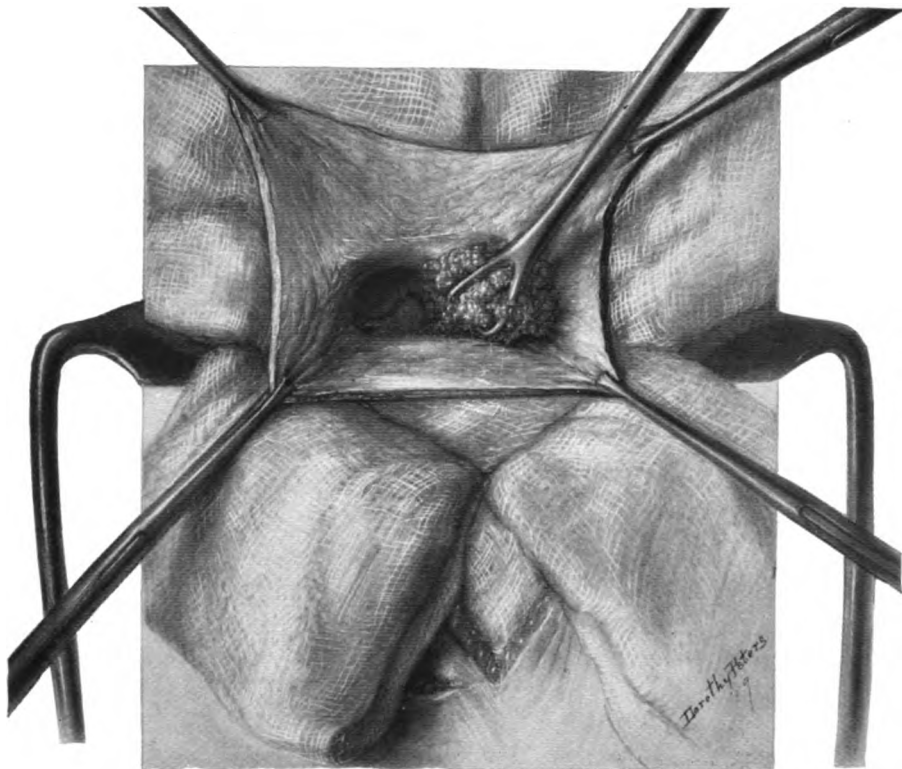


Fig. 123.—Tumor of base of bladder near right ureteral orifice. Incision held open by forceps.

During recent years there has been considerable discussion as to whether the papilloma is a benign or a malignant neoplasm. Some pathologists have concluded that the cells in the base of the pedicle are carcinoma cells, while others believe the tumors to be truly benign.

Although we seldom, if ever, see a recurrence at the site of the

papillary tumor, it is common to encounter a return of the growth in some other section of the bladder. This may be accounted for by grafting on the mucous membrane from the first tumor, by extension through the submucosa, or by multiple lesions to begin with. From the standpoint of the patient, these tumors are certainly malignant, and if not removed will cause death from persistent bleeding and extension. In a few instances—in fact, in two of our cases at St. Mary's Hospital—an implantation of the cells occurred in the suprapubic wound through which the tumor had been removed, and a large and inoperable, rapidly growing, malignant tumor sprang up at this point.

Knowing that recurrences are nearly always local, and that extension to the glands and metastasis to other organs is very late, when the conditions do occur, and also that one of our greatest difficulties in handling a tumor of the base of the bladder, where over 90 per cent. of the lesions begin, is the inability to get a good exposure through a suprapubic or perineal incision, we determined to try to better former discouraging results by incising the bladder in order to get a good exposure of any part, and to do a more technical and radical operation. The first step is to make the incision into the bladder through its posterior wall near the base, in this way rendering all parts accessible. After closing the suprapubic incision in the bladder we have occasionally had the wound open and the urine drain for some time through this opening, but in no instance have we had leakage from the incision through the peritoneal surface, which is no doubt owing to the firmer and more rapid healing of the peritoneum itself.

Carcinoma with thick indurated base and open ulcer involving the entire thickness of the wall occurs less frequently in the bladder, but the only treatment that offers any permanent relief in either of such conditions is a radical removal. The expert cystoscopist tells us the exact size and nature of the growth, also the position and extent of bladder involvement, and it is our endeavor to develop a method of approach and radical removal of the tumor. We must also develop a technic for caring for the injured bladder-

wall so that we may expect results at least as good as we are now obtaining in cases of similar neoplasms in other organs.

Formerly, our chief route of attack was the suprapubic. This

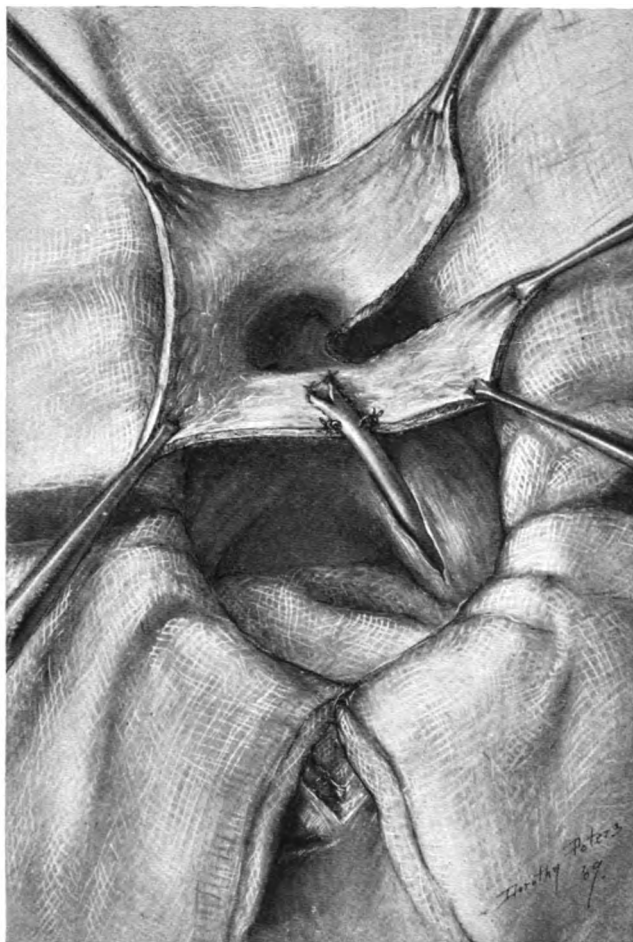


Fig. 124.—Bladder after excision of tumor, including parts of bladder-wall and right ureter. Ureter pulled through opening in peritoneum some distance from bladder and transplanted within the bladder-wall.

does well in case the lesion is in the dome or superior anterior wall; the majority of these tumors, however, occur either in the base or in the lateral wall near the ureteral meatus.

Profiting by the knowledge that the bladder has been accidentally opened many times during abdominal operations, and that the kidneys and ureters have often been exposed through a peritoneal incision without serious consequences to the peritoneum, we determined to open the peritoneal cavity deliberately and pack off the intestines and omentum, preparing this area of the peritoneal cavity for resection of the bladder in a manner similar to that for resection of any organ.

The patient is placed in the high Trendelenburg position, and on opening the abdomen an opportunity is afforded to explore the liver, pelvic peritoneum, and lymphatics. Although we have never seen an extensive involvement of the lymphatics, in one case a metastasis had already occurred in the liver, and in another case the pelvic peritoneum was involved so that an intravesical operation would have been useless and harmful.

The intestines and omentum are packed into the upper abdomen with several large gauze pads, the packing covering the abdominal wound. The posterior bladder wall is grasped with tenaculum forceps, one on either side of the median line, and the bladder lifted into the abdominal incision. A longitudinal incision is made in the posterior wall of the bladder, beginning on its peritoneal surface, in the midline and extending well back to the base of the bladder. The urine is sponged from the bladder as soon as it is opened. This should be done carefully so as not to start a troublesome oozing. If the tumor is on a pedicle, this may be grasped by a pair of curved hemostats and excised with a cautery, leaving the cauterized surface to granulate. The area removed should include a portion of the healthy mucosa and submucosa. When the tumor has an indurated base, it will be necessary to excise a portion of all the coats. At times as much as one-half the bladder must be removed. It is essential to preserve as much as possible of the healthy tissue about the urethral orifice. If the bladder is involved at the ureteral opening, after the diseased portion of the viscus is removed, the ureter is divided near the bladder and drawn into the abdomen through a perforation in the peritoneum close to the remaining half of the bladder, into which it is passed and attached

with catgut sutures. The peritoneum is closed over the exposed ureter in a fold, to insure rapid healing. The remainder of the bladder is closed, and, though greatly reduced in size, will be serviceable, and its capacity will tend to increase (Harris).*

Having completed the intravesical part of the operation the same technic is employed in closing the wound in the bladder as that which would be used in repairing a wound in the intestines or stomach. The first row of sutures begins and ends with the knot inside. These are of chromic catgut placed as a running mattress or Connell stitch, including all the coats. The mucous edges are turned in, not only making an air-tight and water-tight closure but also

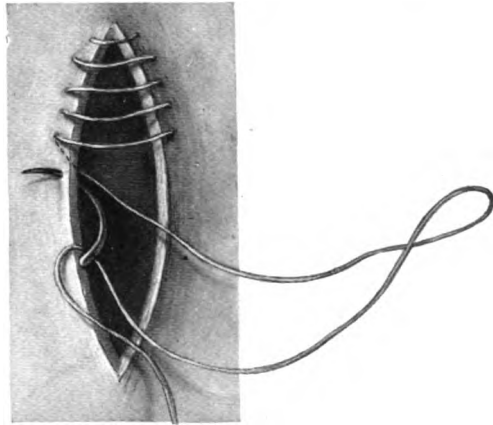


Fig. 125.—Method of closing bladder wound.

controlling all bleeding from the edges. This suture line is reinforced by a linen stitch, including the peritoneum, put in parallel to the previous suture line.

It is not necessary to drain the peritoneum or the bladder unless the growth involves the ureteral opening, or unless the prostate is removed, when it is best to establish an independent drainage through the space of Retzius after the bladder has been closed. As a rule, these patients void their urine frequently the first few days and are more comfortable without a catheter, though if spasmodic contraction persists in the bladder, patients will be made

* Harris: "Ann. Surg.," July, 1902.

more comfortable by small washings of warm boric acid solution to rid them of clots.

Employing this plan of procedure, we have now operated in fifteen cases of tumors of the bladder with one death. In this case the patient was a man, seventy-one years of age, in whom the carcinoma involved nearly one-half of the bladder, including the left ureteral meatus. One-half of the bladder and the lower end of the ureter, which was greatly dilated, were removed. The excision included all the coats of the bladder-wall. The end of the ureter was sutured into the remaining half of the bladder, and the bladder closed entirely. The patient voided urine freely and without aid for the first few days; then the amount gradually diminished, he became uremic and died at the end of the first week. There had been no leakage from the suture line or transplanted ureter, and the peritoneum was clean. The left kidney showed an old hydronephrosis with destruction of almost the entire parenchyma, and the right kidney was swollen and congested from an acute nephritis.

One patient, who had slight involvement of the pelvic peritoneum at the time of operation, died in three months of a recurrence in the peritoneum.

Six patients have lived over one year with no evidence of a return of the trouble. All except two of these patients (one complaining of frequency and one having a stricture which necessitated secondary operation) have been comfortable and apparently well.

One patient has been well ten months, one nine months, one five months, and one one month. In this last case nearly one-half of the bladder was removed and the right ureter transplanted into the left half of the bladder. Since one week after operation the patient has passed clear urine. At first he voided very frequently, but the intervals gradually increased, and at the end of one month he averaged one or two times each night.

One patient with malignant papilloma returned in eighteen months showing a similar tumor in the opposite half of the bladder. This patient was re-operated on, and six months later a cystoscopic examination did not show any evidence of trouble.

One case of a large malignant papilloma in the left wall above the ureteral opening, ten months later showed no evidence of return in the old site, but there were many small pedunculated tumors growing from the margin of the urethral meatus. These were removed and the bases cauterized. The patient has been free from symptoms for four months. We were unable to trace two of the cases.



Fig. 126.—Operation finished. Entire incision and ureter closed over with peritoneum.

The size of these tumors varied from a few centimeters in diameter to a tumor in one instance occupying nearly the entire space of the bladder.

Four of the fifteen patients had more than one tumor. In nine the pathologist reported malignant papilloma. These included all the cases of multiple growths.

In three of the cases the pathologic report was papilloma, probably malignant.

Three cases were of the straight carcinoma type with indurated base involving the deeper coats and having the open ulcer on the mucous membrane surface.

Of the fifteen cases, in twelve the trouble originated in some point of the base of the bladder, and in the remaining three it began in the lateral wall about $\frac{1}{2}$ inch from one ureteral opening. In three instances the ureteral orifice itself was involved and it was necessary to transplant the ureter.

Although we do not advise or believe it necessary to go through the peritoneum in removing tumors in the upper quadrants of the bladder our experience leads us to believe that the greater number of neoplasms of this viscus begin in or near the base, and we can, with very little, if any, greater risk to the patient, do a much more technical and radical operation through the peritoneal incision.

CONGENITAL UNILATERAL ABSENCE OF THE UROGENITAL SYSTEM *

By DONALD GUTHRIE AND LOUIS B. WILSON

CLINICAL REPORT BY DR. GUTHRIE

The following case is reported because of its anatomic and surgical interest. There are many cases reported in the literature of congenital anomalies of the female urogenital system involving one or more of its parts, such as imperforate hymen, atresia of the cervix or vagina, unicornate and bicornate uteri, double vaginas, and, more rarely, the absence of the tube and ovary or kidney and ureter on one side occurring separately or together. Few of these cases have required surgery, except the cases of imperforate hymen, and the atresia of the vagina and cervix, which have been relieved by plastic operations upon the vaginal outlet or the cervix. One anomaly which has been observed, of a somewhat similar nature to the case reported is a bicornate uterus, one side only of which communicated with the cervix and vagina, with the normal menstruation from that side, while the non-communicating side gradually filled with blood, forming a painful suprapubic tumor of the corresponding side. Five examples of this congenital condition have been operated upon at St. Mary's Hospital. In the majority of the cases reported the conditions have been found during routine examinations, at operation, or at postmortem, and have been recorded because of their anatomic interest. From the conditions found in this case, we believe that the life of the patient would have been in serious jeopardy had not surgery intervened.

CASE 28914.—Mrs. P., aged thirty. *Family history* negative. *Personal History*.—Married two years; has never menstruated,

* Reprinted from "Annals of Surgery," Nov., 1909.

but has had, since fourteen years of age, peculiar symptoms at four-week intervals which she has regarded as her periods. These symptoms have been cramping, bearing-down pains through the lower abdomen, backache, and headache. There has never been any vicarious bleeding.

Previous Diseases.—Tuberculous arthritis of the right hip when eight years of age, leaving 2 inches of shortening and accounting for the deformity the patient presents (Fig. 127).

Present Illness.—Four months ago, at a period when she thought she should have been menstruating, the patient had an attack of severe cramping pain through the lower abdomen, which confined her to bed for one week. At the next period, four weeks later, the cramps returned and were much more severe, followed by tenderness over the whole right half of the abdomen. She was in bed two weeks, and it was at this time the tumor was discovered and operation advised and accepted. A letter from the attending surgeon states that on exploration he found a tumor, which he believed to be the uterus, devoid of attachments on the left side. The right side of the tumor was densely adherent, with attachments as high as the liver. The operation at this time was abandoned for fear of causing the immediate death of the patient. He suggests that the tumor was a deformed uterus filled with retained menstrual blood. The recovery from the operation was good and there were no symptoms until three weeks ago, when the cramping pain returned and has continued, the patient being confined to her bed most of the time since.

Examination.—Poorly nourished female, short stature. Scoliosis, due to shortening of the right leg. Heart and lungs negative. Tumor palpable in right half of abdomen, extending from symphysis pubis to right costal arch, which is very near the crest of the ilium because of the scoliosis (Fig. 127). Tumor is fixed and tender.

Pelvis: Rudimentary labia majora, labia minora absent. Complete absence of the vagina, urethra easily admits the examining fingers, and a tumor can be felt high up in the pelvis, lying to the right.

Blood: Hemoglobin 70 per cent.; reds, 3,800,000, whites 9500.

Urine: 1016; alkaline; albumin, trace. Microscopic: erythrocytes.

Cystoscopic examination by Dr. W. F. Braasch: Urethra dilated, bladder normal size, left meatus absent. Dr. Braasch suggests the possibility of but one kidney (right).

Diagnosis.—Abdominal tumor—uterus? Congenital atresia of vagina (absence of left kidney and ureter?).

Operation, January 28, 1909 (W. J. Mayo): Tumor (Fig. 127), found to be the uterus, 18 cm. long and 9 cm. at its lowest widest portion, adherent below to the bladder and above to the under

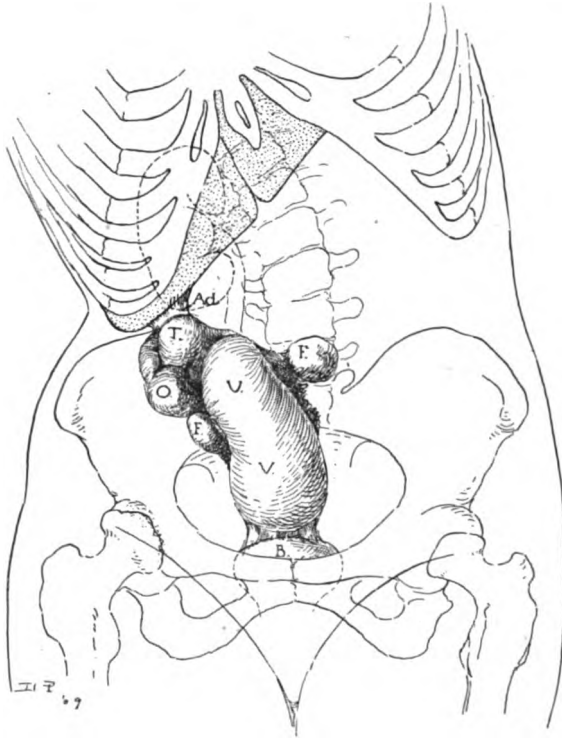


Fig. 127.—Showing location of tumor. U, uterine portion; V, vaginal portion; T, fallopian tube; O, ovary; FF, fibroids; Ad, adhesions to liver; B, bladder with adhesions to closed end of vagina. The enlarged right kidney with absence of left kidney and ureter is indicated. Incidentally also the right hip-joint disease and lateral scoliosis are shown.

surface of the liver by adhesions to the right tube, which was distended. The ovary was cystic. There was an absence of the tube, ovary, and broad ligament on the left side and of the left kidney and ureter. The tumor was very adherent and removed with difficulty. Recovery was uneventful and a recent letter from the patient says she is enjoying good health.

It was not until the specimen was opened in the laboratory that

the true condition of affairs was learned, it being supposed at operation that the whole tumor was uterus and that there was a complete absence of vagina.

Microscopic sections taken from the lower portion of the tumor (Fig. 128) proved the pathologist's belief—that the lower portion of the tumor was the upper portion of the vagina and not cervix—to be correct.

That there should have been a space of 10 cm. between the closed end of the vagina and the perineum is an interesting feature in the case, showing that, originally, only a small part of the vagina was formed and, as the organ grew and filled with blood it followed the line of least resistance and was forced upward into the abdomen.

From the structure of the walls of the tumor it would appear that it had been one of long standing, although the immediate symptoms were acute for the past four or five months.

In a talk with the husband of the patient it was learned that the sexual act per urethram was accomplished at first with very little difficulty, and that coitus had always been gratifying to the patient. There had never been any incontinence of urine, and only a hint of cystitis at one time—six months before the first operation—when there was some frequency of urination, which disappeared after a short time.

PATHOLOGIC REPORT BY DR. WILSON.

January 28, 1909, there was received in the pathologic laboratory, from the surgical service of Dr. W. J. Mayo, a specimen from Case No. 28914, the clinical data of which is detailed above by Dr. Guthrie.

The specimen consisted of an irregular ovoid mass 18 cm. in length and 9 cm. in its greatest transverse diameter. External examination showed the tumor to consist of what was apparently a distended uterus with closed cervix, and with but one tube and ovary—the right—attached thereto. Two small fibroids were present, the larger on the dorsal surface and the smaller on the ventral, both attached well toward the fundus. The tube and ovary were bound down to the fundus of the uterus as shown in

Fig. 127. Both were very much distended. The broad ligament

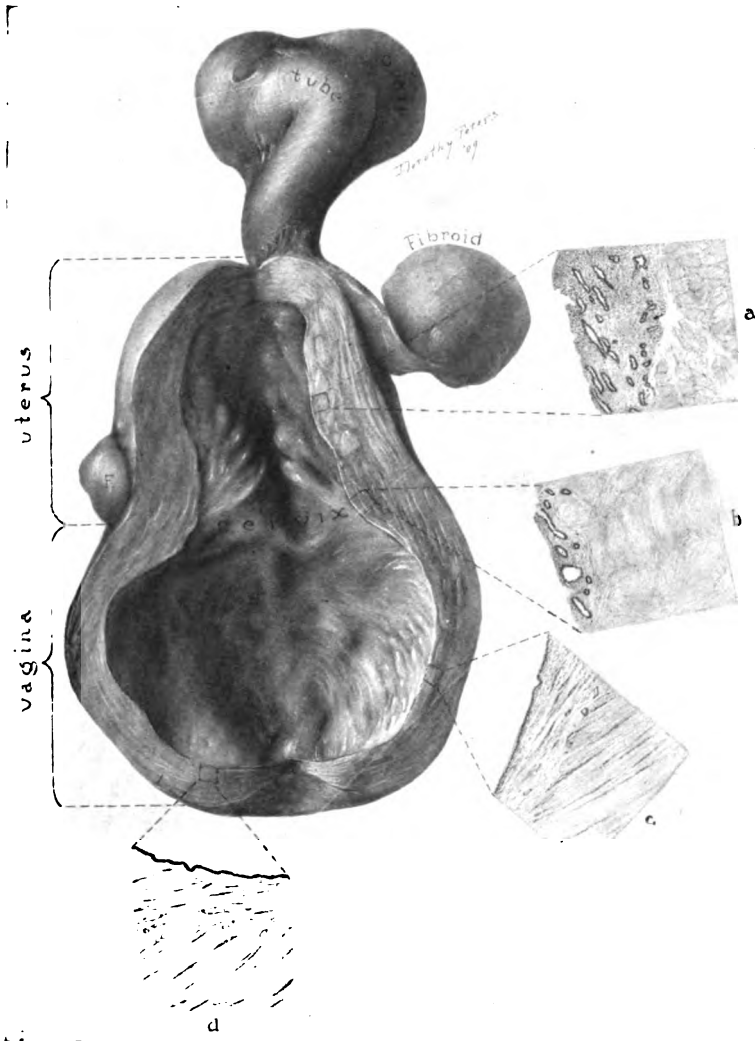


Fig. 128.—Two-thirds natural size, with sections 10-diameter magnification.

on this side consisted of a contracted mass of adhesions. Numerous remains of adhesions were still attached to the organ, particu-

larly where the fundus and tube had been attached to the liver, and at the lower portion, where attachments had connected it with the bladder. There was no evidence of ovary, tube, or broad ligament on the left side.

The specimen was opened longitudinally on the ventral surface, but well to the right of the median line. It was found to be tensely distended with blood—black, thick, and “tarry.” The tube was filled with the same material, as were also two or three cysts of the ovary, each of which seemed to be the remains of a much distended corpus luteum.

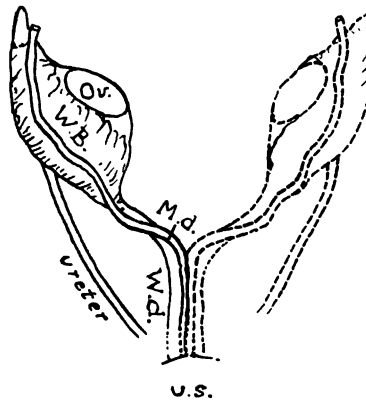


Fig. 129—Hypothetic embryologic development, early stage; *Ov.*, Ovary; *WB*, Wolffian body; *Wd.*, Wolffian duct; *Md.*, Müllerian duct; *Us*, Urogenital sinus. The dotted portions on the left side and at the lower end of the Müllerian and Wolffian ducts are those portions which are supposed to have remained undeveloped in the present case.

The lower portion of the tumor was more distended than the upper, and its walls were thinner and smoother. The upper half was fairly well marked off from the lower by an indefinite ridge, which suggested an imperfectly formed cervix.

Microscopic examination of the mucosa from the upper portion of the tumor (Fig. 128, *a*, *b*,) proved that this portion was uterus with thick walls, lined with tubular mucosa, not very different from that in the normal uterus.

The lower and thinner walled portion showed, microscopically, mucosa (Fig. 128, *c*, *d*) with flattened epithelium, such as is found in the vagina normally. The walls of the vaginal portion, though

thinner than those of the uterine portion, were still enormously thickened, when compared with normal vaginal walls. There was complete absence of the lower end of the vaginal portion.

The specimen would appear, therefore, to be the result of the development of the embryologic elements of the right side only, with a destruction of the lower ends of these elements, resulting in a failure of the Müllerian and Wolffian ducts to unite with the urogenital sac. This hypothesis is further explained in the dia-

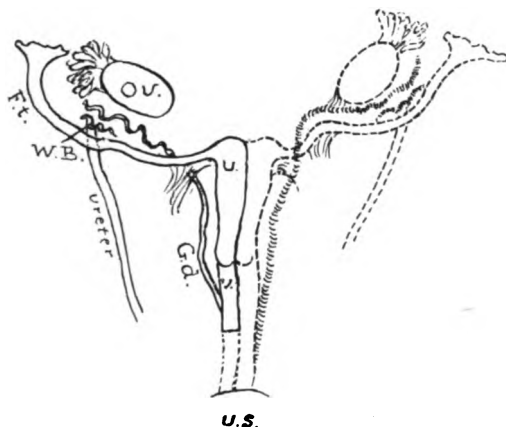


Fig. 130—Hypothetic embryologic development, later stage. Parts correspond to those in Fig. 128, except remains of Wolffian duct are designated. *Gd.*, Gaertner's duct; *U.*, uterus; *V.*, vagina.

grams, Figs. 129 and 130, in which the parts represented by dotted lines are those which probably failed to develop. Such a hypothesis would account also for the absence of the left kidney and ureter. It is difficult to understand why there should have been a failure of the lower portions of the Müllerian and Wolffian ducts to develop, thus leaving the large space, probably 10 cm., between the closed end of the vagina and the perineum. Since the tumor was removed by the suprapubic route there was no opportunity to examine the intervening structures.

RELATION OF ANOMALOUS RENAL BLOOD-VESSELS TO HYDRONEPHROSIS *

BY WILLIAM J. MAYO, W. F. BRAASCH, AND W. C. MACCARTY

SURGICAL CONSIDERATIONS

BY W. J. MAYO

My attention was first called to the relation existing between anomalous blood-vessels and intermittent hydronephrosis some six years ago, while I was exploring the pelvis of a kidney which was bound down by adhesions producing a kink in the ureter. The ureter was separated just at the pelvis of the kidney, and all the tissues concerned outside of the ureter were divided without previously catching them in forceps. The result was a very smart hemorrhage, which was difficult to control because the artery in this case, one of two, came directly from the aorta. The vessel was about the size of the radial. After this, in operating for such conditions, the ureter was separated and any tissue present was carefully inspected before division.

It is a significant fact that in twenty out of the twenty-seven cases of hydronephrosis herewith reported anomalous blood-vessels were present, and the obstruction in each instance was at a point where these vessels crossed the ureteropelvic juncture. The vessels passed to the lower pole of the kidney a little to one side of the midline, and varied from the size of a knitting-needle to that of the radial. In all but two the arteries came from the renal, sometimes passing in front and sometimes behind the ureter, but in either of these positions the pressure of the artery on the ureter or adhesions between the vessels and pelvis seemed quite capable of developing the kink. In a few of the cases adhesions between these vessels and the margins of the pelvis were responsible for the obstruction.

* Reprinted from "The Journal of the American Medical Association," May 1, 1909, vol. lli, pp. 1383-1388.

I have no doubt that many patients have been operated on without recognition of the rôle played by such anomalous blood-vessels, and that these vessels were separated, tied, and divided by the operator without his attention being called to the exact condition.

Admitting the possibility of error as to the actual nature of the obstruction, or that we have in some instances overestimated the importance of the vascular anomaly, there is no getting away from the fact that such blood-vessels were present and abnormal. In nearly every case it was possible to prove absolutely the etiologic relationship of the blood-vessel to the kink.

In our series no patient was accepted for operation in whom the kidney pelvis did not easily contain 50 c.c. or more of fluid, and in the greater number of them the pelvis had a capacity of from 60 to 180 c.c. or more.

The kidney was exposed by an oblique incision parallel with the quadratus lumborum muscle, extending high up into the costovertebral angle, avoiding the ilio-inguinal and the iliohypogastric nerves. If necessary, the twelfth rib was divided behind the erector spinæ muscle. In doing this the pleura was sometimes opened, but such accidental pleurotomy, in which the lung was easily seen, did not result in pneumothorax or any other ill effects, if the patient was lying face downward during operation.

The kidney was drawn well out on the loin and the ureter isolated next to the pelvis from the posterior side. Careful dissection revealed the blood-vessels, if they were present. In twelve of the twenty-seven cases it was considered wise to enlarge the uretero-pelvic juncture by a plastic operation in addition to the division of the blood-vessels which were present in seven of the twelve. In nine the operation was that proposed and carried out by the late Christian Fenger, whose early description of valve formation of the pelvis of the kidney is classic.

We found that the easiest way to accomplish this procedure was to open the dilated pelvis $\frac{1}{2}$ inch above the ureter, passing a grooved director down into it. The strictured portion was then split for $\frac{3}{4}$ inch in length, half on the ureter and half in the pelvis, and closed by plastic suturing with No. 1 catgut through all the coats, after the

plan of the Heinecke-Mikulicz interrupted sutures pyloroplasty. The fat and fascia lying in the neighborhood connected with the pelvis was raised as a plastic flap, planted across the line of union, and held in place by a few catgut sutures.

After the uteropelvic sutures had been placed the union sometimes looked unreliable, as though leakage might occur, but in our experience if the suture line was properly covered with this fatty fascial flap there has been no leakage. Before using this latter device, in two cases following operations, there was leakage of urine. One leaked for ten days, and a second, a large infected hydronephrosis, for seven weeks, but with spontaneous healing in each instance.

In three of the patients with very large hydronephrotic sacs the ureter was completely detached, its end split for $\frac{1}{2}$ inch like a cuff, and then reimplanted into an opening made in the lateral wall of the pelvis, using the two-row interrupted suture method with No. 1 catgut, much like gastrojejunostomy. This was covered with the fatty fascial flap previously described. Primary union took place in all three.

After the plastic operation the kidney was anchored in such position as to keep the site of union without tension or bending. Folds of rubber tissue were used for drainage, never gauze.

In two large infected hydronephroses the remnant of the kidney was removed with the sac.

CLINICAL CONSIDERATIONS OF INTERMITTENT HYDRONEPHROSIS CAUSED BY ANOMALOUS RENAL BLOOD-VESSELS. (By W. F. Braasch.)

Cases of hydronephrosis are usually grouped under two anatomic headings: congenital and acquired.

Congenital Hydronephrosis.—In the light of recent investigation the number of cases in the congenital class has become much larger than that of cases in the acquired. The etiologic congenital conditions commonly observed are (1) anomalous renal blood-vessels; (2) atresia of the ureter near the renopelvic juncture, and (3) displaced kidneys.

Acquired Hydronephrosis.—The non-congenital conditions which may be found in the urinary tract causing renopelvic distention are (1) strictures following inflammatory and traumatic lesions, (2) stones partially occluding the tract, (3) tumors within the urinary tract or exerting extraneous pressure on it. Thus it will be seen that there is a large number of causes for and conditions in which hydronephrosis in the broad sense of the term may be found.

These various etiologic factors have been observed, however, to a great extent at postmortem examination. The observations at autopsy differ quite widely from clinical and surgical reports. Morris quotes the Middlesex Hospital Reports to the effect that almost 90 per cent. of the cases of hydronephrosis found at autopsy were due to extraneous pressure of abdominal tumors. On the other hand, Israel reports but one of his series of forty cases in which operation was performed for hydronephrosis as due to extraneous tumor pressure.

On reviewing the list of operations for hydronephrosis performed by Drs. W. J. and C. H. Mayo at St. Mary's Hospital, one is impressed with the number of cases in which anomalous blood-vessels were found to be the only visible cause of renopelvic distention.

Of the twenty-seven cases of definite hydronephrosis collected from the operation records, twenty were due to such blood-vessels. To prove that these blood-vessels were the cause of the hydronephrosis it was shown that in thirteen of these twenty cases severing the anomalous vessels sufficed to remedy the condition.

It is only within the last few years that our attention has been called clinically to the comparatively frequent existence of hydronephrosis. Patients frequently appear complaining of intermittent attacks of pain in the upper lateral abdomen the causes of which have remained unidentified for years. The condition has been regarded variously as a diseased condition of the appendix, gall-bladder, or pelvic organs, or as a renal or ureteral lithiasis. With these various diagnoses surgeons have repeatedly opened the abdomen only to find a hydronephrotic kidney, or to overlook the underlying condition entirely. The patient frequently appears

with the appendix removed, but with no cessation of symptoms. While it is often difficult to distinguish intermittent hydronephrosis clinically from some diseases of the neighboring organs, nevertheless the condition presents certain clinical data which are very suggestive.

Diagnostic Data — Subjective. — Age: The symptoms usually manifest themselves in the young adult at about the time when the body has reached its fullest growth, a fact which is strongly suggestive of congenital etiology. The average age at which the symptoms commenced was twenty-two years. Most of the patients, however, had had their trouble a number of years, ranging from one to twenty.

Attacks: Intermittent hydronephrosis manifests itself by attacks of acute abdominal pain. The frequency of attack is variable, appearing at intervals of a week or two to years, although the usual interval is a month or two. In several instances patients with long-standing trouble complained of a steady ache continuing between the acute attacks. The onset is usually sudden, although some patients give a history of premonitory ache in the affected side. The attacks frequently come on toward evening, and often after some unusual exertion. In twelve cases the right side was affected, and in eight the left side. There is no evident reason why one side should be oftener-affected than the other. All the patients except three referred the pain to the upper abdominal quadrant and to the back near the costovertebral angle. In nine of the cases the pain was referred to the lower quadrant as well, and in one case to the lower quadrant alone. As a rule, the pain is not referred along the course of the ureter as distinctly as in a kidney or ureteral stone, but remains localized. It is usually acute for hours, and a soreness in the affected side may continue for a day or two following the attack. The pain is not, as a rule, as acute as in that attending gall-stone and kidney-stone colic. Again, the pain may be absent in the affected side, the condition remaining latent until the retention becomes so great that the patient notices a tumor in the abdomen. The non-affected side may also be the seat of some pain, which is usually due to the engorgement of the normal kidney as

the result of a compensatory hypertrophy, although the possibility of a bilateral hydronephrosis is always to be considered.

In women, as a rule, the attacks appear independent of menstruation; in fact, if the patient states that they usually come on at the menstrual period one might suspect pelvic trouble or neurosis.

Gastric Symptoms: Gastric disturbance is frequently quite prominent, vomiting or nausea accompanying the attacks in nearly every case; in fact, one patient complained only of stomach symptoms, but with closer investigation it was discovered that he also had pain referred to the lateral abdomen accompanying his gastric disturbance.

Diagnostic Data—Objective.—In many cases of intermittent hydronephrosis the objective symptoms are of little value. Where there is more or less permanent distention of the sac, however, the tumor may be palpable in the upper abdominal quadrant and kidney zone. This is so in about a third of our cases. The mass has a distinct cystic soft feel, and with one hand on the back may be palpated through the abdomen with gentle pressure. In several instances the tumor was quite easily palpable one day and the next could be scarcely felt, the variation in the size of the sac being, of course, dependent on the degree of obstruction to urinary drainage. If the tumor is palpable as a cystic mass, occupying more or less of the upper abdominal quadrant, it will probably have but little secreting substance left.

Slight tenderness on pressure over the kidney area was complained of by a few of the patients, in marked distinction to the tenderness of an inflamed appendix. Marked renal dystopia and scoliosis were not noticed in the series of cases; in fact, no pronounced congenital anomalies were noted in any case except one in which the kidney was found to have two distinct pelves and ureters. One pelvis was hydronephrotic and the other was normal.

x-Ray Examination: x-Ray examination in itself is of no value in diagnosis unless the kidney shadow can be made definite enough to bring out the outline of the kidney. It can be employed to some advantage, if there is any doubt after the cystoscopic examination, by combining the two methods.

Argyrol and bismuth solutions have been injected into the pelvis and radiographs made to demonstrate the size of the pelvis. The ureteral catheter may likewise be radiographed as it lies coiled in the dilated pelvis. The data acquired from pelvic distention as described below, however, are much simpler.

Differential Diagnosis.—1. *Appendicitis:* Strange as it may seem, the condition with which intermittent hydronephrosis is most frequently confounded is appendicitis. About one-fourth of the patients in our series had their appendices removed previously. Many others had been told that their symptoms were due to appendicitis and were advised to have the appendix removed. Hydronephrosis is differentiated by (a) location of pain, which is higher up and is referred usually to the costovertebral angle, (b) intermittence of attacks, (c) absence of fever and prolonged prostration, (d) absence of marked tenderness over the appendix, (e) presence of pus in the urine, and (f) cystoscopic findings.

2. *Gall-stones:* The confusion of this condition with hydronephrosis is possible if the pains are localized below the right costal margin and if accompanied by gastric symptoms. Gall-stones may usually be differentiated by (a) the fact that the pain is referred more to the pit of the stomach, radiating thence to the back, (b) the more irregular periodicity of attack, (c) the fact that this is more pronounced with constant nausea and vomiting, (d) the fact that the attack, as a rule, is more acute, (e) the more rapid onset and disappearance of pain, and (f) icterus. If the symptoms of gall-stones are doubtful and the pains are referred below, however, it is advisable to examine the urine carefully for pus and to measure the size of the renal pelvis.

3. *Nephrolithiasis:* Hydronephrosis and renal calculi will frequently be manifested by similar symptoms. The location and character of the pain, intermittence of attack, and accompanying gastric symptoms may all be similar. The history in cases of calculus does not, as a rule, extend over so long a period of time, nor is there such frequent occurrence as with hydronephrosis. Furthermore, lithiasis is to be differentiated by the facts that (a) the symptoms are usually more severe, (b) there is a history of blood

in urine, (c) the microscopic urine examination usually shows a few blood-cells. After all, the radiograph is the essential method of diagnosis of lithiasis, and when checked by the ureteral catheter is about infallible.

Pancreatic and ovarian cysts may, in exceptional cases, be confused with a latent symptomless hydronephrosis, since a large hydronephrosis may extend to the center of the abdomen, and a pancreatic cyst may, on examination, give a similar "through-and-through" feel. The clinical symptoms, as a rule, suffice to differentiate the conditions, while the renopelvic distention establishes the diagnosis.

Urinary Data.—1. *Subjective Urinary Data:* These are of comparatively little value, as but few of the patients complain of even the slightest bladder irritation. In several cases it was possible to obtain a history of diminution in amount of urine just preceding and during the attack, with a polyuria following. The polyuria is probably due to the reflex inhibition of secretion in the unaffected kidney rather than to occlusion of the contents of the hydronephrotic sac and its consequent liberation. In one case a large hydronephrotic sac was distinctly palpable, which on pressure would decrease in size and the patient would immediately urinate a quantity of fluid of low specific gravity containing pus-cells. Gross blood was not reported in any of the series of cases.

2. *Microscopic Examination of Urine:* The urine is not usually distinctly purulent on macroscopic examination. Microscopic examination will, however, reveal pus-cells in the urine, though it may require repeated examinations to demonstrate their presence. The number of pus-cells varies continually; they may even be absent for a period depending to a great extent on the drainage. Their presence is of much more importance than that of casts, of which there are usually but a few present. Blood-cells are not often found, although in three cases a few were present. In several cases no pus-cells were found in the mixed urine, whereas in the specimen obtained by ureteral catheterization the urine of the affected kidney showed a considerable number of pus-cells.

3. *Phloridzin Test:* An attempt was made in five cases of

hydronephrosis to ascertain the functional capacity of the two kidneys by means of the phloridzin test. In every case the sugar remained absent from the urine in both kidneys for an hour after injection—a peculiarity of secretion in cases of hydronephrosis to which Albarran was first to call attention.

4. *Cystoscopic Examination:* In some cases intermittent hydronephrosis can be diagnosed with comparative certainty from the clinical picture, particularly if the kidney tumor is distinctly palpable. Nevertheless, since renopelvic distention is frequently not definitely palpable, and since the symptoms simulate those of various renal conditions, a more exact method of diagnosis should be employed. This is given us in cystoscopic examination, including ureteral catheterization and measurement of the size of the renal pelvis.

The bladder mucosa is usually normal in appearance unless some local cystitis should incidentally complicate it. The ureteral meatus next attracts our attention. In about half of our cases it was found long and more or less pendulous. The ureteral peristaltic contraction about the meatus is usually indistinct and the urine dribbles or comes with an occasional weak spurt. The whole is suggestive of lack of tone, in contradistinction to the hyperirritable meatus one frequently sees with a stone in the lower ureter. Still, too much stress should not be laid on meatoscopy, for its findings are often misleading.

A catheter is next slipped into the ureter and slowly passed up toward the renal pelvis. In about two-thirds of the cases more or less obstruction was encountered near the ureteropelvic juncture. With but one exception it was possible to slip the ureteral catheter by the obstruction and enter the renal pelvis. Although it is impossible definitely to differentiate the character of the obstruction caused by the stone from that of constricting anomalous blood-vessels, still the former obstruction is abrupt, and a grafting may be palpable, while the latter, which is smooth, may give way on a little pressure.

Whereas in the normal ureter and pelvis the ureteral catheter can be inserted to a length of from 30 to 40 cm., the dilated pelvis

will permit 50 cm. or more to be coiled up within itself. The only exception to this was noted in a case in which the obstruction of ureteropelvic juncture was so great that a catheter could not be passed by it. The obstruction is usually felt at a length of from 20 to 25 cm. of catheter, however, and is easily pushed by. Below the obstruction it will frequently happen that little or no urine will come through the catheter. As soon as the obstruction is passed the urine will usually run freely with a steady drip and without the ureteral contraction. An ounce or so of fluid will frequently drop away without peristaltic hesitation. A similar rapid secretion is, however, sometimes observed with the nervous hypersecretion of oversensitive individuals, in whose cases the urine may flow incessantly for a long time without any ureteral contraction. The urine thus collected is extremely pale and will show at least a slight turbidity on close inspection. Such turbidity may be due to pus, but in some cases it is due to phosphates which frequently are precipitated in the more or less alkaline residual urine. The urine so called may appear clear on inspection, and yet there may be enough pus-cells in it to determine an infected condition. Therefore, a microscopic examination is necessary in every case. After collecting sufficient urine for examination and letting enough urine run out to empty the hydronephrotic sac, at least partially, the next step is to determine the degree of pelvic dilatation.

Pelvic Distention: Kelly first called attention in this country to the fact that if the pelvis of the kidney is overdilated an artificial renal colic is produced. This fact is taken advantage of to measure the size of the renal pelvis. The normal pelvis will hold from 5 to 15 c.c. before pain is caused. At times the otherwise normal pelvis will be distended to 30 or even 40 c.c. before the patient complains of any definite pain. This occurs usually in more or less hysterical subjects, and may possibly be explained by a hysterical anesthesia similar to that observed in the cornea or pharynx. After the pelvis has been partially drained one should be able to inject at least 50 c.c. of fluid into the renal pelvis before pain is caused, to determine an abnormal dilatation.

└ The distending fluid is colored with methylene-blue to determine

whether there is any return flow alongside the catheter. This return flow is, as a rule, not present to any noticeable extent, but if markedly so will negate the value of the findings.

After the degree of dilatation has been determined, the injected fluid is allowed to drain partially through the catheter. It escapes with a steady flow resembling that of a siphon and without any expulsive force. The amount of fluid injected before pain is produced varies, of course, with the degree of renal dilatation. In several cases 200 c.c. were injected without causing pain. If more than 150 c.c. can be injected, but little secreting substance remains in the affected kidney.

The typical cystoscopic findings in hydronephrosis would consist of (1) an occasional weak spurt of urine from the pendent meatus, (2) a slight obstruction to the catheter near the ureteropelvic junction, (3) about 50 cm. of catheter inserted into the ureter and pelvis, (4) a rapid drainage through the catheter of a pale urine containing a variable amount of pus, (5) at least 40 c.c. of fluid injected without return flow before producing renal colic.

Summary.—The frequency with which a type of renopelvic distention is observed, caused by anomalous blood-vessels constricting the upper ureter and characterized by intermittent attacks of abdominal pain, is so marked that the condition deserves to be considered as clinically distinct at least, if not anatomically so. The diagnostic data are:

1. Appearance of symptoms in the young adult.
2. Intermittent attacks of abdominal pain referred to the kidney zone and occurring with more or less regularity during a number of years.
3. Cystic tumor palpable in about a third of cases.
4. Presence of small amounts of pus in urine.
5. Usual absence of hemorrhagic urine, temperature, and bladder irritability.
6. Cystoscopic findings as outlined above.

RELATION OF ANOMALOUS RENAL BLOOD-VESSELS TO HYDRONEPHROSIS. (By William Carpenter MacCarty.)

For many years both extensive and mild grades of hydronephrosis have been observed at autopsy, and extensive grades have been seen at operation. These latter observations, however, were usually made in cases in which the original pathologic condition has been marked by further changes, such as adhesions, distention of the pelvis and kidney. In many of them it was impossible to determine the exact etiology.

Since the early experience of Dr. Mayo in encountering a severe hemorrhage during separation of adhesions, which may or may not have been the sole factor in the production of the hydronephrosis, our attention has been drawn to the vessels which he so frequently encountered extending from the aorta or renal vessels to the lower pole of the kidney.

These observations led to a careful study of the relation of the vessels to the obstruction in the ureter.

Irregularities of the renal arteries are encountered in about 25 per cent. of dissected bodies (Quain). Of these, Quain states that branches of the renal artery, or an accessory artery, instead of entering at the hilus, sometimes reach and penetrate the gland near its upper or lower end, or on its anterior surface.

Such anomalies we have found also at operation, but associated with distention of the kidney pelvis which had been previously diagnosed by artificial distention.

In some cases it is impossible to determine whether the anomalous vessel is from the aorta itself or from the renal, on account of the limited field of operation.

During the last year in four of the cases described by Drs. Mayo and Braasch, I made sketches during operation. In these cases the vessel ran anteriorly to the ureter and entered the lower pole (Figs. 131-134). In about 75 per cent. of all of our cases this was true.

Merkel describes early cases of hydronephrosis at autopsy in which the vessels were also posterior to the ureter.

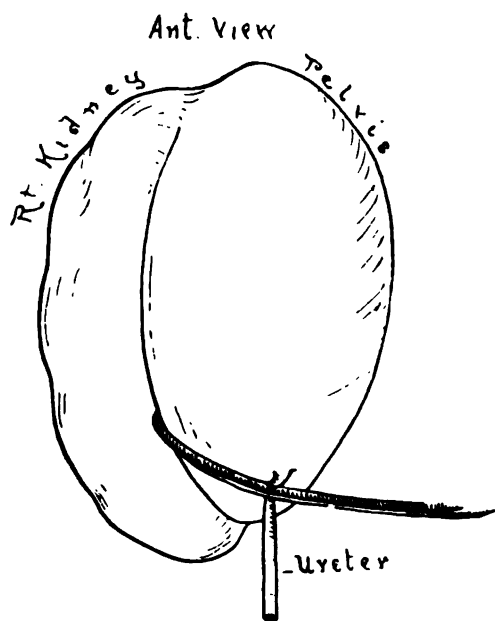


Fig. 131

Post. view

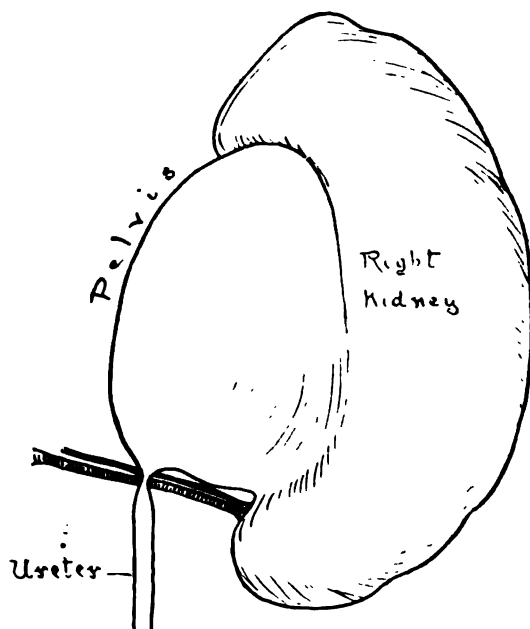


Fig. 132

Ant. view

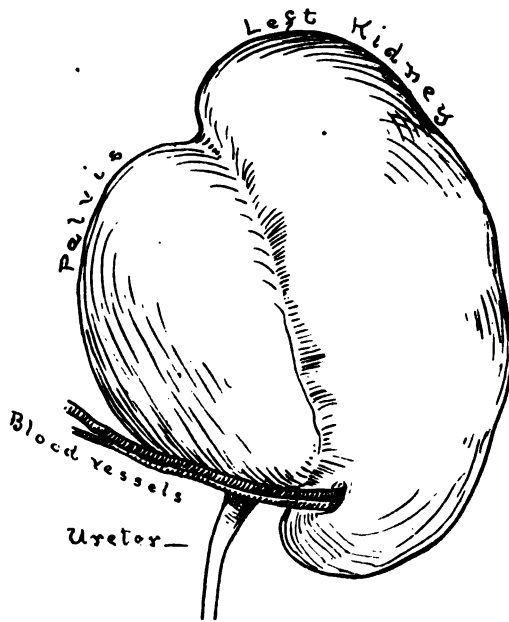


Fig. 133.

Post. view
Rt. Kidney

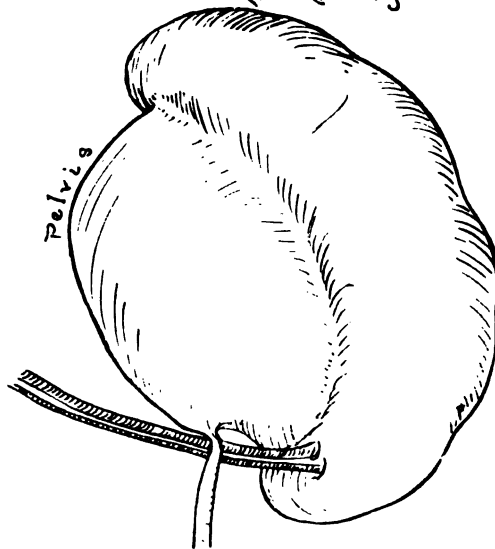


Fig. 134.

Figs. 131-134.—Hydronephrosis: sketches made during operations in four cases, showing anomalous blood-vessels running anteriorly to the ureter and entering the lower pole of the kidney.

Ekehorn, in twenty-five cases of hydronephrosis, found the accessory vessels anterior to the ureter in 64 per cent. and posterior in 28 per cent.

The pathologic sequence in cases of hydronephrosis associated with anomalous vessels seems to be dependent on some other factor than the anomalous vessel—that is to say, anomalous vessels in the kidney occur in a larger percentage of normal kidneys than in kidneys showing hydronephrosis.

There is some reason for the sagging of the kidney, thus allowing the ureter to come in contact with the vessel, which normally is usually not in contact with the ureteropelvic juncture.

Most of those who have studied the condition of hydronephrosis believe that the attacks not infrequently occur following diminution of perirenal fat or general laxity of the abdominal organs after pregnancy or illness.

We do not know how much this factor is responsible for hydronephrosis, but the fact remains that the anomalous vessels form a suspension bridge over which the ureter hangs. Whether the point of contact of the ureter with the vessel is at the normal ureteropelvic juncture is difficult, perhaps impossible, to say.

At the point of suspension the ureter is bent on itself, thus forming a kink. As the angulation of the bend becomes more acute the inner wall of the approximating sides of the ureter form a valve, the *Klappenmechanismus* of the German.

Around the vessels and ureter adhesions are usually found. These are not marked and do not obscure the relation of vessels to the formation of the kink in mild cases.

Not all pathologists and surgeons believe that a vessel ventrally placed in relation to the ureter can cause hydronephrosis, but all agree that a vessel dorsally to the ureter may cause such a condition.

The facts remain, however, that mild grades of intermittent hydronephrosis clinically occur, and at operation show distention of the pelvis, a kink in the ureter, an anomalous blood-vessel anterior or posterior at the point of kinking, extending from the renal vessel or aorta to the lower pole of the kidney. After ligation

and section of the vessel the cases do not show any tendency to recurrence of the condition.

NOTE.—The following references may be found of interest on this subject:

1. Fenger: "Konservative Operation für renale Retention infolge von Stricturen oder Klappenbildung am Ureter," "Arch. f. klin. Chir." (Langenbeck's), 1900, lxii, 528.
2. Ekehorn: "Die anomalen Nierengefäße können eine entscheidende Bedeutung für die Entstehung der Hydronephrose haben," "Arch. f. klin. Chir." (Langenbeck's), 1907, lxxxii, 955.
3. Merkel: "Die Hydronephrose und ihre Beziehung zu akzessorischen Nierengefäßen," "Virchow's Arch. f. path. Anat.," 1908, cxci, 534.

SOME DATA ACQUIRED WITH THE AID OF THE URETERAL CATHETER *

By W. F. BRAASCH

With the development of cystoscopic technic the various possibilities of the ureteral catheter are being revealed. Experience has demonstrated that there is little or no danger of renal infection through cystoscopic manipulation, provided that reasonable precautions are taken. Of the thousands of ureteral catheterizations made at St. Mary's Hospital, we have no record of a single infection.

We have found the various data acquired through the use of the ureteral catheter to be of much value in the diagnosis of renal conditions. Although the ureteral catheter was originally intended for the segregation of the separate urines, we have learned to recognize its value in acquiring further information concerning conditions present. It is with these latter data that this paper will deal.

The length of catheter which can be inserted into a ureter varies widely, depending upon (1) size of catheter, (2) flexibility of catheter, (3) rigidity of ureter and renopelvic walls, (4) size of renopelvis, and (5) actual obstruction to the catheter. If a flexible catheter, size 5 to 6 Fr., is used, the normal limits will be found to vary from 28 to 45 cm. of catheter. In 1000 normal ureters I have found the average length of catheter inserted to be 34 cm. The usual limits are from 30 to 40 cm. If the length is found to be between 27 and 30 cm., one must suspect the possibility of pelvic encroachment. If less than 27 cm. of catheter can be inserted, an obstruction must be inferred.

* Reprinted from "Surgery, Gynecology, and Obstetrics," Oct., 1909, pages 461-465.

The fact that more or less difficulty is encountered in passing the catheter in about a third of the ureters I catheterize has led me to a closer study of such obstructions.

It is possible for the ureteral catheter to meet with obstruction at any part of the ureter: meatus, bladder-wall, free ureter, or at the ureteropelvic juncture. The fact that the ureteral catheter is obstructed in its course does not necessarily mean that a stricture or a stone is blocking the ureter. In fact, it may not be a surgical obstruction at all, as has been frequently found on subsequent surgical exploration.

Obstructions to the ureteral catheter may, therefore, well be regarded in two groups, *surgical* and *non-surgical*.

Non-surgical obstructions include those caused (1) by physiologic conditions, (2) by non-surgical inflammatory conditions in the urinary tract.

One is frequently surprised to find that in otherwise normal individuals the ureteral catheter will meet with definite obstruction in its passage. This may be encountered in any part of the ureter, but only in exceptional cases above the angle where the ureter leaves the bladder.

Obstruction is frequently found in hypersensitive individuals. It is especially common in the male, in whom the already hypersensitive urethra and bladder are thrown into a spasm by the instrumentation. The spasmodic condition of the vesical musculature may be so intense as to prevent the passage of the catheter after it has entered the meatus. More frequently the impassable obstruction is met at the angle where the ureter leaves the bladder-wall, which is probably rendered acute by the contracted vesical musculature. The findings are particularly confusing should the clinical symptoms be suggestive of possible surgical ureteral obstruction, or if the radiograph shows a *possible* stone in the ureter. That obstructions are due to spasmodic contracture of the vesical ureteral musculature is further proved by the fact that (1) such obstructions can often be passed by injecting fluid through the catheter to distend the ureter beyond, (2) on surgical exploration the ureter is found normal.

Particularly in inflammatory conditions do we meet with such obstructions. In an irritable cystitis it is quite common to meet with more or less difficulty in passing the catheter. If chronic pyelitis is also present, the obstruction may be met with at any distance up the ureter. Whether such obstruction well above the bladder may be due to ureteral spasmodic contracture, or to the actual inflammatory changes of the ureter, would be difficult to say.

In considering surgical obstructions we find that those caused by stone, traumatic stricture, and tuberculosis are common to all parts of the ureter. Whereas, stone is the most frequent cause of obstruction, yet it may not, as we know, cause any hindrance at all. The percentage of stones which will permit the ureteral catheter to pass them unnoticed must be a variable one, depending upon the operator, catheter used, size and shape of stone, ureteral dilatation, etc. The obstruction being palpable, it is frequently possible to distinguish a stone by detecting the uneven surface as the catheter slides by, or by a peculiar clinging to the catheter on its withdrawal. Of forty cases of stone in the ureter which came under our observation during the last two years, 80 per cent. were felt in passing the catheter. Of thirty cases of stone in the pelvis, 70 per cent. were palpated. For various reasons, such as a very adipose abdomen, small soft stones, stones embedded in fat, stones obscured by the iliac artery, the radiograph may show an indistinct shadow or none at all. On the other hand, phleboliths, glands, calcareous deposits, etc., may cast shadows similar to stones. Therefore, every case with symptoms strongly suggestive of renal or ureteral calculus, in which the radiograph is indefinite, should be checked up by the ureteral catheter.

Another rather common form of obstruction to the catheter is that caused by tuberculous ulceration of the ureter. From the ulcerative nature of the lesion it is quite evident that the ureter, which is so frequently involved, might have cicatricial and inflammatory constrictions. There are several obstructions palpable to a greater or less degree. They are not, as a rule, at the usual places of narrowing. More often they may occur along the canal of the free ureter and may give way to a little pressure if

a small catheter is used. At times the obstruction is situated just beyond a crater-like golf-hole meatus, and may be so low that the catheter will not penetrate far enough to collect any urine.

Obstructions common to the meatus, other than those common to the entire ureter, may be caused by cystic dilatation, bladder tumors, and congenital narrowing.

Cystic dilatation of the lower ureter may be of various degrees, so great as to partially fill the bladder. When large, it may be impossible to enter with the ureteral catheter. In one case which came under my observation the large sac was squeezed down by the cystoscope until the meatus was located by the spurting urine. The ureter was entered with some difficulty with a fine-pointed catheter. A distinct grating was palpable just above, which, on operation, was found to be due to numerous small stones, and on pelvic distention, a hydronephrosis was determined.

The lax condition of the ureter in hydronephrosis may permit sagging of the meatus so that it appears cystic, and difficulty may be encountered in entering the ureter. The obstruction encountered by the ureteral catheter when the meatus is entered is not necessarily due to stone, but may be due to inability of the catheter to find the ureter lumen.

Bladder tumors frequently obstruct the meatus. When the tumor is large and is situated near the meatus, it may sometimes be impossible to find the meatus at all. A small bladder tumor may be situated near the meatus, leaving the opening visible, and still be the cause of symptoms of renal obstruction. This was well illustrated in a patient who came under my observation complaining of frequent renal colics. Cystoscopic examination revealed a small papilloma near the meatus. A ureteral catheter met obstruction just within the opening, which was passed after a little pressure, and a 6.0 c.c. hydronephrosis was demonstrated above. On removal of the growth the symptoms ceased. Evidently the tumor had extended into the tissues about the ureter, and with accompanying inflammatory changes had occasionally occluded the lumen, giving rise to renal colic.

Obstruction at the pelvis of the kidney presents another group

of possibilities. If the ureteral catheter meets with an obstruction at from 20 to 27 cm. from the meatus, we must infer an obstruction about the ureteropelvic juncture. Among the possible causes for such an obstruction I have found: ureteropelvic stone, dead kidneys with atrophied or fatty pelvis, small soft kidney with atrophied pelvis, anomalous blood-vessels constricting the upper ureter, atresia of the upper ureter without evident etiologic factors, deformities of the pelvis resulting from encroaching tumors. The nature of an impassable obstruction at the pelvis, is of course, impossible to ascertain by means of the ureteral catheter alone. A ureteropelvic stone can usually be determined by the *x*-ray. Dead kidneys, especially those with discharging sinuses, often have but a shell of secretory substance remaining in the mass of inflammatory renal tissue. The pelvis will then either be destroyed or remain as a small pocket and obstruct the catheter at a length of from 23 to 27 cm. The dead kidney may undergo fatty degeneration and the pelvis be filled with masses of fat, as occurs in cases of long standing processes. A pelvic stone may be the original cause, and when embedded in the mass of fat, may not be revealed by the *x*-ray.

Renal tumors encroaching upon the pelvis, or stones free within the pelvis, may offer a distinct obstruction just after the catheter enters the pelvis, and may not permit more than 27 to 28 cm. of catheter to be inserted.

Constriction of the upper ureter resulting from congenital anomalies may, with a few exceptions, be passed with a little pressure. The obstruction may even be so slight as to be scarcely felt. As the catheter glides by, a round smooth obstruction is usually made out, particularly if the condition is due to anomalous vessels. Such obstructions in the upper ureter are met at shorter lengths than those at the pelvis itself, usually from 20 to 23 cm. The obstruction once passed, a variable amount of catheter can be coiled up in the renal pelvis. If the obstruction is a stone, less catheter can be coiled up than if an anomalous blood-vessel is the cause of obstruction. The stone, as a rule, causes a smaller sac and partially fills the sac with its volume. The dilatation above

a constricting blood-vessel or other congenital anomaly will permit the entire length of catheter to be inserted without palpable friction. One frequently finds a normal pelvis and ureter which will permit as much as 45 cm. and occasionally 50 cm. to be inserted. On further examination these will prove to have little or no dilatation. Furthermore, some friction is always noticed even if the catheter is soft. It is possible that in such a lax pelvis the catheter may double back on itself and re-enter the upper ureter. Although 50 cm. or more of catheter inserted is indicative of a pelvic dilatation, we have still more definite means of ascertaining the size of the pelvis.

The nerve-supply of the renal pelvis is peculiar in that: (1) It probably gives the pelvis little or no active motive force. (2) The pelvis is but mildly sensible to a stimulus, such as a ureteral catheter or a small amount of fluid. (3) If the pelvis is irritated, it will not alone react violently itself, but will also reflexly stimulate the nervous mechanism of the entire urinary tract, and the subject will suffer what is known as renal colic. Such colic can be artificially produced by overdistending the renal pelvis. We know that the renal pelvis will usually contain from 5 to 15 c.c. of fluid. From my records of about 1000 pelvic distentions, the normal average capacity of the pelvis was found to be 11 c.c. This capacity will be found to vary in the following conditions: (1) In over-irritable conditions it will hold less than 5 c.c. (2) A certain group of pelves will contain as much as 30 or even 40 c.c. of fluid without colic being produced. (3) Pelves which contain more than 40 c.c. of fluid before colic is caused are abnormally dilated and may be considered surgical.

Group 1.—There are a number of conditions which will cause the pelvis to react after 2 or 3 c.c. of fluid have been injected. Frequently the hyperirritability is caused by stone in the pelvis. It is nearly always present if the stone does not interfere with the urinary drainage and cause pelvic dilatation. It frequently occurs in chronic pyelitis. If the pelvis is encroached upon by renal tumors, as with hypernephromata or cystic degeneration, colic is occasionally produced after a few cubic centimeters are injected.

Group 2.—Pelves permitting the injection of 20 to 30 c.c. of fluid before colic is produced, other pathologic conditions being excluded, do not require surgical intervention *per se*. Such patients may present themselves with a clinical history warranting surgical exploration, which procedure may reveal no dilatation nor any cause for the symptoms. The findings occur usually in individuals with other marked neurotic symptoms. The diminished sensibility may be explained by a hysterical anesthesia similar to that frequently observed in the pharynx or cornea.

However, a moderate dilatation of the pelvis may exist with a number of surgical conditions. The dilatation caused by a stone partially obstructing urinary drainage from the pelvis is not usually an extreme one. The pelvis may be partially filled by the stone itself and still show dilatation. Our records show hypernephromata with secondary degeneration and various forms of pyonephrosis, with pelvic dilatation varying from 20 to 40 c.c.

Group 3.—A surgical dilatation of the pelvis may be caused by an obstruction at any point in the urinary tract below the pelvis. Urethral and vesical obstruction excluded, there remains still a long list of ureteral obstructions. Operation records show that ureteral obstructions are due to congenital anomalies, stone, cicatricial changes, and extraureteric pressure, in the order of their frequency. The obstruction having been met and passed, the first evidence of dilatation above is observed by a steady rapid flow of a light-colored urine, without peristaltic hesitation. Enough urine is allowed to flow to at least partly empty the pelvis. The pelvis is then distended with fluid until pain is created. It has been our experience that unless a pelvis holds 40 c.c. before colic is produced, it will not show a dilatation on exploration. Frequently the pelvis will hold as much as 200 c.c. without discomfort being caused. If 150 c.c. can be injected, but little secreting substance remains in the kidney and a nephrectomy is indicated.

Technic.—The syringe with which we inject the distending solution is an ordinary Murphy aspirating syringe with a capacity of 12 c.c., to which a blunt needle is attached. A graduated cylinder might be employed and the distending solution allowed to run in

by gravity. The injected fluid is a 2 per cent. boric acid solution, warmed and colored with methylene-blue. The solution is colored to determine whether any of the injected fluid returns alongside the catheter. If a return flow is visible, the value of the findings is negated, for it would be impossible to determine even relatively the amount of fluid remaining in the pelvis. There was a return flow in but one of the cases of hydronephrosis that came under my observation, and that was because the catheter met an impassable obstruction.

It is quite logical that the fluid should remain in the dilated sac, and not run back after a few cubic centimeters are injected. For this reason no surgical dilatation exists if a return flow occurs before 40 c.c. are injected even though no colic is produced.

In distending the pelvis care must be taken not to inject any more fluid than is necessary to cause pain. Unless the fluid is injected slowly, and immediately stopped on producing renal pain, a severe colic will follow, which frequently prostrates the patient for several days.

It has been claimed by several observers, that the nature and location of the pain created are of value in differentiation from the pain the patient usually complains of. However, we have not found the subjective differentiation of much value.

Résumé.—1. Obstructions to the ureteral catheter are due to a great variety of causes.

2. They can, however, usually be identified, and are of much corroborative value in renal and ureteral diagnosis.

3. The length of catheter that can be inserted into the normal ureter and pelvis varies from 28 to 45 cm. As a rule, it is from 30 to 40 cm. If the obstruction is felt at 20 to 25 cm., an obstruction in the upper ureter is to be inferred. If only from 25 to 27 cm. can be inserted, the obstruction is at the pelvic juncture. If from 27 to 29 cm. are passed, some obstruction within the pelvis is usually present.

4. Non-surgical obstructions are frequently met with in the vesical ureter. They are probably caused by (a) a spasmodic constriction of an irritated or inflamed vesical musculature; (b)

the angle at which the ureter leaves the bladder-wall is rendered more acute by the contracted bladder muscle.

5. A stone in the ureter can be felt with the ureteral catheter in about 80 per cent. of cases.

6. Stone in the pelvis can be felt with the catheter in about 70 per cent. of cases.

7. In most cases of advanced renal tuberculosis obstruction is met with in the ureter—frequently multiple.

8. If 50 cm. or more of catheter can be inserted without friction, pelvic dilatation usually exists.

9. A smooth moderate obstruction at from 20 to 25 cm., with evidence of dilatation above, is often caused by obstructing anomalous blood-vessels.

10. The capacity of the renal pelvis can be approximately ascertained by distending it with a measured amount of fluid. If the capacity is more than 40 c.c., it is surgical; if more than 150 c.c., a nephrectomy is indicated. A return flow before 40 c.c. are injected negates the value of the findings.

11. Differentiation of the symptomatic pain from the pain caused by overdistention is not practicable.

DUCTLESS GLANDS

TREATMENT OF THE POSTERIOR CAPSULE OF THE GLAND IN THYROIDECTOMY, BASED ON THREE HUNDRED AND SEVENTY-FIVE OPERATIONS FOR GOITER*

By CHARLES H. MAYO

The thyroid gland presents a most interesting problem to the anatomist, physiologist, and surgeon. From an anatomic standpoint, the gland is intimately associated with most of the important structures of the neck. Anteriorly it is beneath the group of sternohyoid and thyroid muscles. It covers a considerable portion of the trachea, in front and laterally, is closely attached to this structure, as well as to the cricoid and thyroid cartilages.

Knowledge concerning the function of thyroid and associated ductless glands has been greatly advanced, in the last few years, by numerous contributions from physiologists and scientists; yet our present knowledge concerning them is undoubtedly still limited, although their importance in maintaining the metabolism of the body has been proved beyond question.

To the surgeon the thyroid and associated structures are of intense interest from an operative standpoint. While aseptic and antiseptic methods have removed one of the most serious of former risks of surgery, that of infection, we have in this local field so many other dangers and complications, which must be constantly guarded against, that the operation for goiter will always rank high in major surgery.

The thyroid gland is entirely inclosed by a fibrous capsule. Posteriorly this capsule divides into layers, one of which passes

* Read before the American Surgical Association, May 7, 1907. (Reprinted from "Surgery, Gynecology, and Obstetrics," July, 1907, pages 26-30.)

behind the esophagus to unite with that of the opposite side, while another layer does the same between the trachea and esophagus. The recurrent laryngeal nerve arising from the pneumogastric, passes up by the side of the trachea behind the gland, and next to the esophagus, to enter the cricothyroid membrane. On the right side this nerve is intimately associated with the inferior thyroid artery, passing either under or over it. On the left side it is somewhat more deeply situated, and less often associated with the artery. From the various layers of fascia which inclose all of these structures, and the intimate relation of the thyroid to the trachea, larynx, and esophagus, we can readily see the possibility of serious pressure effects, caused by a growth of the gland, or the development of tumors within its substance.

The common carotid artery and jugular veins may become greatly distorted and displaced by growths of the gland. Nerve-trunks, such as the recurrent laryngeal and vagi, occasionally become paretic from continued pressure. Paresis of one or both recurrent laryngeal nerves, affecting the voice, may be one of the symptoms caused by the pressure of goiter; and all cases should be examined with the laryngeal mirror before the operation, to determine this point, as, if the paresis be on one side only, the sound vocal cord may possibly compensate by advancing across the midline. Otherwise in such conditions the paresis may be temporarily so increased, following operation, as to lead the operator to think that he has injured a nerve.

The parathyroid bodies are four little gland-like structures, usually situated behind the thyroid gland, two on each side. The upper one is most commonly at the side of the larynx, close to the esophagus and superior thyroid artery. The lower one is located close to, or below, the inferior thyroid artery. These glands may be displaced, increased, or decreased in number; and while usually behind the intimate capsule of the gland, they may be inclosed with it in the capsule, in which case an ordinary extirpation would remove these glands with the thyroid.

Our present knowledge indicates that a most unfortunate complication, tetany, which occasionally follows removal of goiter, is

caused by the loss of, or injury to, the parathyroids. These bodies can usually be recognized—small pinkish or yellow fat in color, flattened ovoid bodies, ranging in size from minute structures to 1.5 cm. in length.

All cases in which the thyroid glands are increased in size, whatever their pathology, are known as goiters. They may be classified

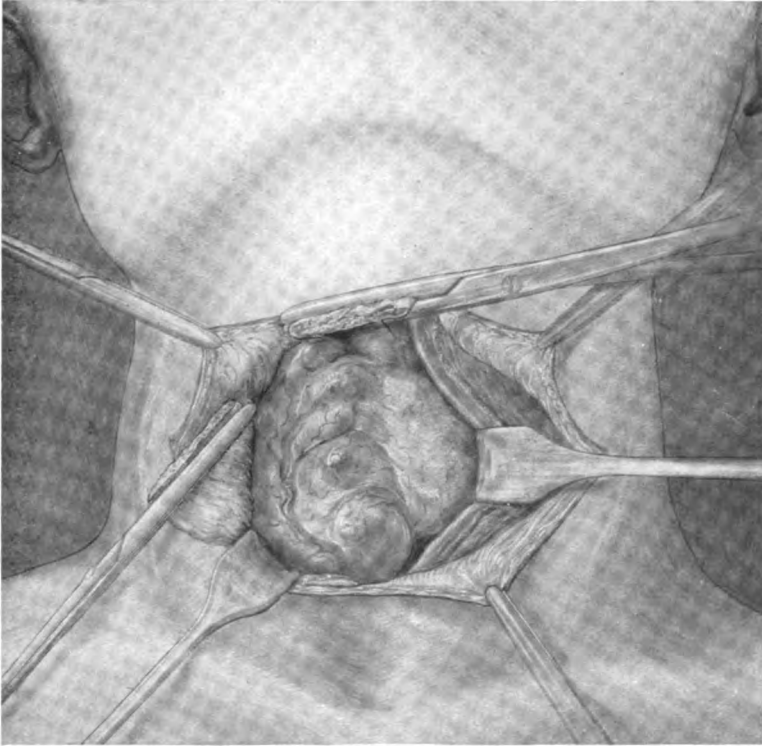


Fig. 135.—Greatest exposure of the gland. High muscle section on one side.

in two varieties, diffuse and circumscribed. The diffuse variety usually retains the general conformation of the normal gland with the right lobe somewhat larger. Such enlargement is often seen in hyperthyroidism, general colloid, and diffuse adenomata.

The circumscribed growths may be single or multiple nodules developing in one or more lobes. Encapsulated growths are

frequently seen, such as fetal rests, adenomata, and cysts, which have developed rounded tumors, having grown within the capsule of the gland proper, which may be destroyed or greatly injured by pressure atrophy.

Local anesthesia is only occasionally indicated in special respi-

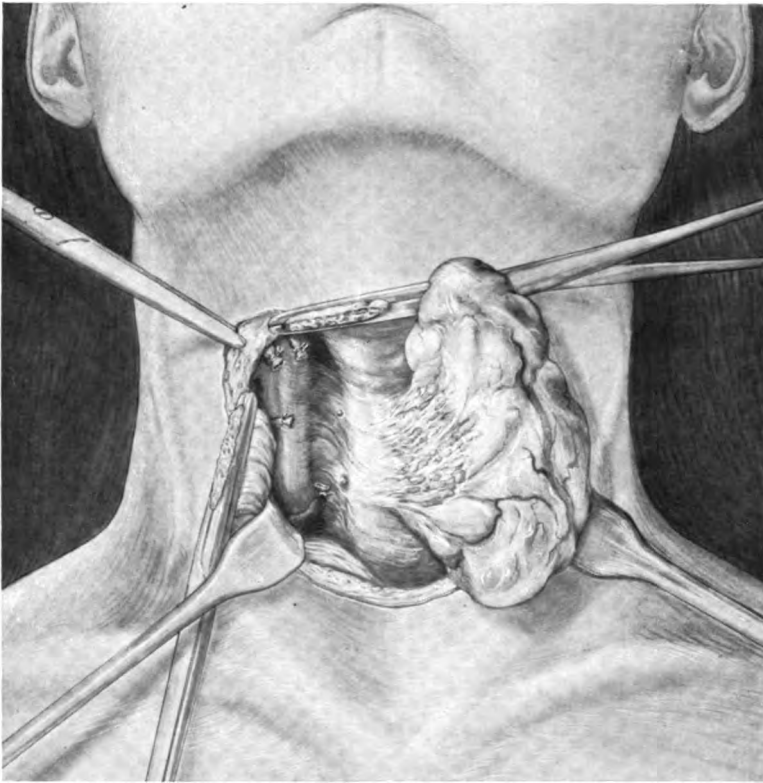


Fig. 136.—Showing position of vessels and rotation of gland over and across trachea. Posterior capsule in the field of vessels.

ratory difficulties, complicated by myocardial lesions. General anesthesia is preferred, and is aided by previously administering $\frac{1}{4}$ grain of morphin and $\frac{1}{100}$ grain of atropin about twenty or thirty minutes before the patient is brought to the operating room. The patient is placed in the reverse Trendelenburg position, head up

with shoulders elevated, to expose the operative field. Ether is then administered by the open-drop method.

The Kocher transverse-collar incision gives good exposure with few disadvantages. The platysma myoides muscle is turned above and below with the skin. If muscle section of some of the sternohyoid and thyroid group is necessary, they are cut between forceps placed upon them near their upper insertion.

Those cases which present encapsulated tumors or cysts are usually removed by perforation of the gland-substance and enucleation of the tumor, hemorrhage being controlled by upward lifting of the capsule and gland. The cavity left is closed and obliterated by a running locking suture of catgut. While myxedema might follow this method, should all of the gland-substance be removed, as well as the tumor, there will be no danger of injury to those important structures situated behind the capsule.

In diffuse adenomata Mikulicz advocated a resection of large portions of the gland, often on both sides. This method also saves the posterior capsule. We have usually favored extirpation of one lobe in such cases and also in hyperthyroidism. The gland is elevated; all vessels entering and leaving the thyroid are double clamped, and cut between the forceps, as seen in the dissection, the most important ones being ligated at the time. The whole lobe is finally elevated with the fingers slipped behind it from the side. The capsule is opened along the side of the gland and brushed back with gauze into the wound as the gland is lifted and rolled over toward the midline. All vessels are caught at once by forceps, taking care in applying them to grasp the tissues in line with the long axis of the body. In this manner the surgeon is less likely accidentally to include nerves which run in the same direction.

All small bodies of a gland-like appearance, seen about the thyroid, are carefully preserved; especially is this done on the posterior surface, where there are few glands other than parathyroids. The wound areas left from small growths are not drained. Drainage is instituted after the removal of large tumors, while all cases of hyperthyroidism are drained from one to three days, a separate incision being always provided for that purpose. A complication

in the form of tracheal injury may occur during operation. Such an accident usually causes wound infection. The esophagus has also been opened in removing goiter, but if this complication is discovered, and the opening closed at once, it is not so serious,

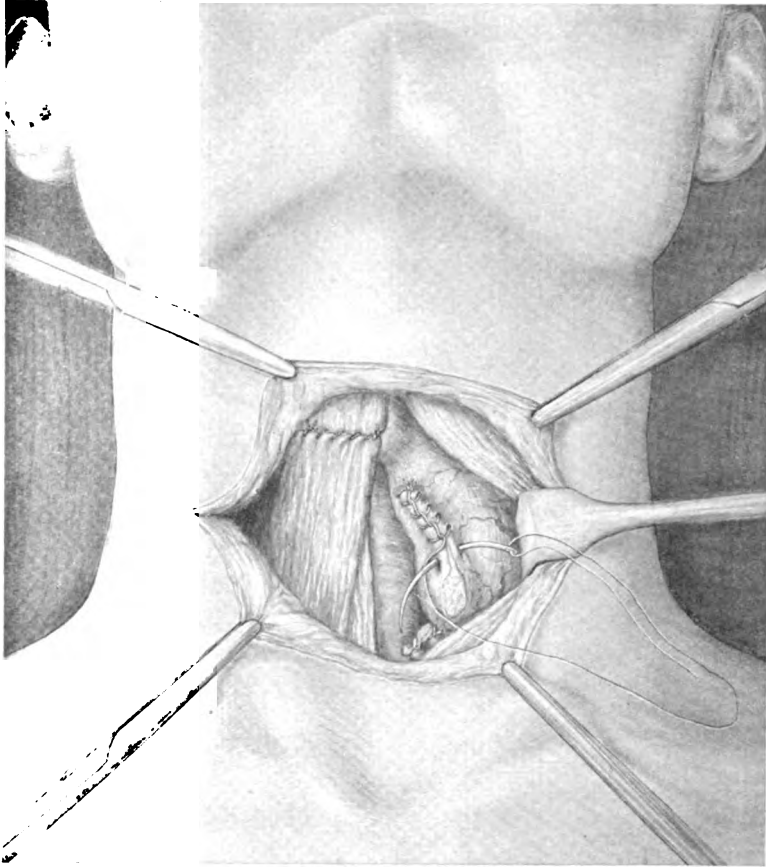


Fig. 137.—Showing muscle suture near attachment and interlocking suture of cut gland.

according to cases reported, as that of unexpected perforation, occurring at a later period.

There is not much danger in this operation from air embolism, as the superficial veins are early clamped in dissection, or cut

between ligatures. Should a vein be injured in the deeper dissection, there is usually sufficient free blood to cover any opening. One of the great dangers, however, is secondary hemorrhage, usually from the slipping of a ligature on the superior thyroid artery caused by including muscle. One can readily understand that, with a dilated artery and a circulation much above normal

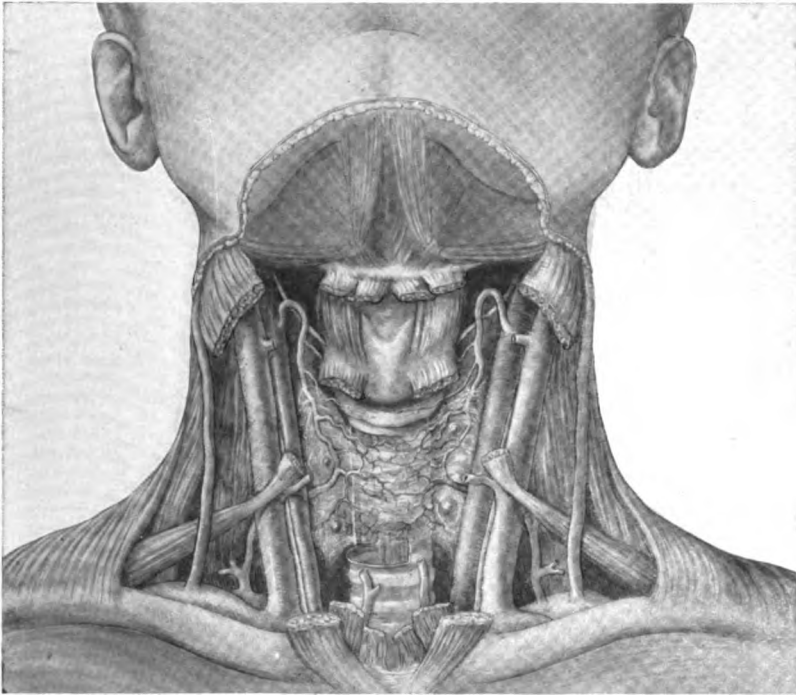


Fig. 138.—Showing blood-supply and anastomosis of vessels. Parathyroids behind capsule. Trachea sectioned showing recurrent laryngeal nerve.

in rapidity, a most alarming hemorrhage may occur in a very brief period.

In our experience, derived from over 375 operations for goiter, we have seen but one case develop tetany, and that only in the slightest degree. Some myxedema or other evidences of hyperthyroidism have been present in a few cases before operation, and

in none has this condition been increased. In five cases we have increased the hoarseness, previously manifest, from the effects of pressure.

From the practical experience gained from 375 operations and more, we believe that the preservation of the posterior capsule of the thyroid gland, whatever be the method of its accomplishment, protects against many of the dangers of thyroidectomy.

GOITER, WITH PRELIMINARY REPORT OF THREE HUNDRED OPERATIONS ON THE THYROID *

By CHARLES H. MAYO

The general impression to be obtained from a review of the surgical literature of America would be that diseases of the thyroid gland are greatly on the increase. This, probably, is not true, but the public has learned that operations on goiter are not as fatal as was supposed from the results obtained from operations made as a last resort on patients suffering with this disease and in a moribund state. The fact is that the mortality attending the operation (excluding cancer and advanced cases of exophthalmic goiter) compares very favorably with other major surgery; and, in the hands of those experienced, with much of the so-called minor surgery.

SURGERY OF THE THYROID

Surgery of the neck never seemed to experience the popularity of that of the abdomen, and goiter operations are not sought even to-day by the majority of surgeons. Those who were competent to operate have not sufficiently encouraged operative relief until absolute necessity rendered the mortality so high as to be almost prohibitive. The lay prejudice was such that operative measures were permitted only in the most advanced cases, while semi-surgical, medical, mechanical, and electric treatment flourished. In most cases death came slowly and was looked on as a relief from suffering, a result which satisfied everybody; but the

* Reprinted from "The Journal of the American Medical Association," Jan. 26, 1907, vol. xlviii, pp. 273-277.

death which follows operation is a shock to all, and in but few instances is there a consideration of the fact that medical treatment has previously failed. Neither is the urgent necessity of the operation nor the desperate condition of the patient taken into account, but the death is made a debit against the surgical side. Especially is this true in cases of exophthalmic goiter.

Surgery of the thyroid is a most satisfactory operation, giving as it does, immediate relief with brief disability. The best known surgeon of to-day in this work is Kocher. Wherever his name is mentioned it is associated with the removal of goiter, and it is through his monumental work in this line that his reputation has traveled far and wide. In 70 operations upon ordinary goiter before 1850, Kocher placed the mortality at 40 per cent. In 400 operations between 1850 and 1883, it fell to 15 per cent., and since 1883 it has dropped to less than 3 per cent., Kocher's own mortality being 0.4 per cent. in simple cases. In Reverdin's report of the causes of death in 93 cases, respiratory conditions, suffocation, and pneumonia caused 43 deaths, hemorrhage 19, infection 13, shock and nerve injury 9, cardiac failure 6, while only 4 were from tetany and myxedema.

DISEASES OF THE THYROID

The diseases of the thyroid gland may be classed in four groups—functional derangements, inflammations, hypertrophies, and tumors. Each of these groups presents material for exhaustive study, and much has been written concerning them in monographs and books on the ductless glands and various types of hypertrophies and tumors. The present paper will discuss briefly the general subject of goiter and some of the points of interest in relation to operative work.

In Europe there are certain localities in which such large numbers of the people have goiter that the disease is considered endemic. The condition is said to be due to the use of waters from the mountainous districts, but the disease is also endemic in some of the flat countries, as in the Indian Punjab and plains of Lombardy. Hereditary influences may also play a part. In the United States

there are no such marked localities. The disease occurs in all regions and climates, among rich and poor, food and water having apparently no definite relation to its cause. Some regions appear to have more than their due proportion, because they possess more



Fig. 139.—Large cystic goiter measuring 31 inches in circumference, including neck.

accurate medical observers. The same may be said of exophthalmic goiter, which is often attributed to shock, with about the same amount of proof that birth-marks follow maternal impressions.

THE THYROID GLAND

Development.—The thyroid gland is developed from a median process of the pharyngeal hypoblast which bifurcates below and

forms pyramidal lobes, *i. e.*, the isthmus and part of each lateral lobe, the remainder being formed from lateral outgrowths from the pharynx. In most vertebrates they remain distinct, but unite in mammals, the various portions being fused in the human embryo at about the seventh week. In some cases the fusion is incomplete, and separate thyroid bodies are noticed laterally or below the normal location. In others one or more lobes may be missing. The foramen cæcum in the tongue marks the point of inversion and the remains of a disappearing structure, the duct or tract of the gland. It is in these lines of inversion, like branchial cysts, that accessory thyroids are found, and in the upper tract especially are so often the cause of serious conditions, as when found in the tongue and also in the median line of the neck above the isthmus. The so-called pyramidal lobe is present in from 30 to 40 per cent. of all people.

Anatomy.—The thyroid body is somewhat like a horseshoe in shape and rests on the trachea, with one lobe on each side, connected below by the isthmus which crosses the upper tracheal rings. These lobes are about 2 inches long, being smaller at the upper pole. The right one is usually the larger, and the entire weight is from 1 to 1½ ounces. The gland is invested by a thin fibrous capsule which divides posteriorly, a portion lining the posterior and inner surface, while a part passes to the opposite side behind the esophagus. This investment explains the production of pressure from tumor growths on both of these structures and the occasional appearance of tumors between them. Fibrous bands also unite the gland to the trachea, which cause the thyroid to move with it. Trabeculæ of connective tissue pass into the gland structure and subdivide into the framework for the alveoli and small vesiculæ and serve as a space for the lymph-channels which extend throughout the gland, performing the function of the ducts of this organ, as has been pointed out by King, Horsley, and Hürthle. They have shown that these channels contain the same colloid secretion as is found in the gland vesicles.

The blood-supply of the thyroid, considering its size, is remarkable for its extent and also for the freedom of anastomosis. The

superior thyroid artery from the external carotid supplies the upper pole on its inner side, dividing and entering the capsule. The inferior thyroid from the thyroid axis enters the capsule below at the hilus. The main veins are the superior, middle, and inferior, although many others seem to develop in diseased organs. The

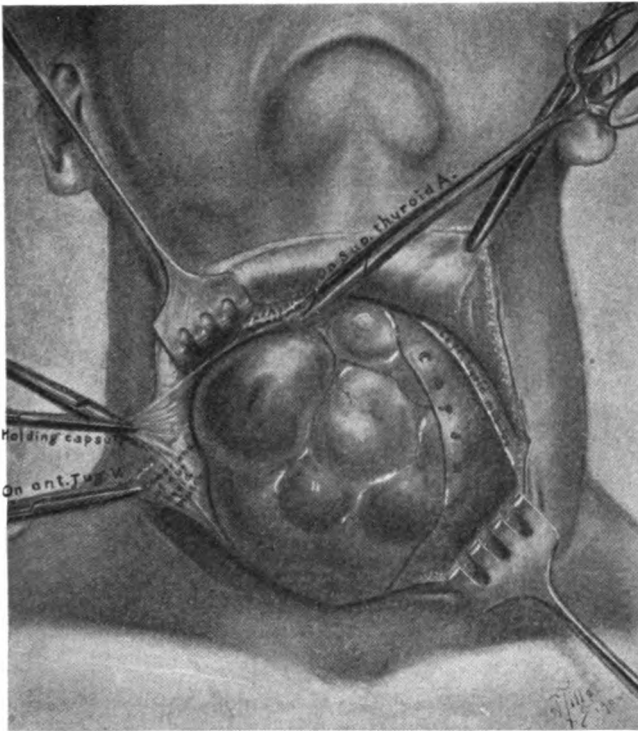


Fig. 140.—Enucleation of cystic goiter; capsule opened.

nerve-supply is from the sympathetic. In intimate relation with the right inferior thyroid artery is the recurrent laryngeal nerve, which lies in the space between the trachea and the esophagus, and is so often affected by pressure of tumors, by operation, or by scar tissue as to cause hoarseness. On the left side the recurrent

is usually more deeply set and not in such close relation to the artery, as was pointed out by Sifton.

Parathyroids.—In each side of the neck behind or within the investing capsule of the gland are the parathyroids, two small gland-like bodies somewhat resembling in structure the suprarenals. Little is known concerning them, but they appear to be closely associated with the thyroid in function, and it is probable that when the whole of the thyroid body is removed and the operation is not followed by untoward consequences the patients have active parathyroids or accessory thyroids. It is claimed by Humphrey that a fatty degeneration of these bodies is found in exophthalmic goiter. I am unable to verify the statement. The experimental study of the parathyroids would tend to show that they hold a most important position in the metabolism of the body. Their removal causes tetany and, as they are small, they may easily be removed on the back capsule of the extirpated gland. The removal of one or two in an operation for colloid goiter may not prove serious, but in exophthalmic goiter it may prove most dangerous in adding to the shock. To some extent we can see how enucleation of encapsulated goiters would seldom cause either tetany or myxedema, as a portion of the gland is left and the capsule protects the parathyroid as well as the laryngeal nerve.

Function and Secretion.—Much has been written on internal secretions and, while our knowledge has grown continuously, there is still very much to learn about the ductless glands. A consideration of the functions of the various structures of the body shows that they are controlled by accelerator and depressor nerves, the stimulating and inhibiting forces. Every muscle action to be effectively controlled is balanced by another which opposes it. In other words, there must be a constant equilibrium of forces. When we consider the effects of the secretion of the suprarenal gland with that of the thyroid, it would seem that in several respects they oppose each other. Such a fact explains, to some extent, the condition of cretinism, in which, from lack of a functioning thyroid, there is an arrest of development. Through the unopposed action of the suprarenal bodies there is a capillary con-

traction with circulatory starvation which affects the cerebral cortex, as well as other tissues. The intermittent feeding of thyroid extract causes increased growth and general improvement in appearance, with considerable mental development. The mental

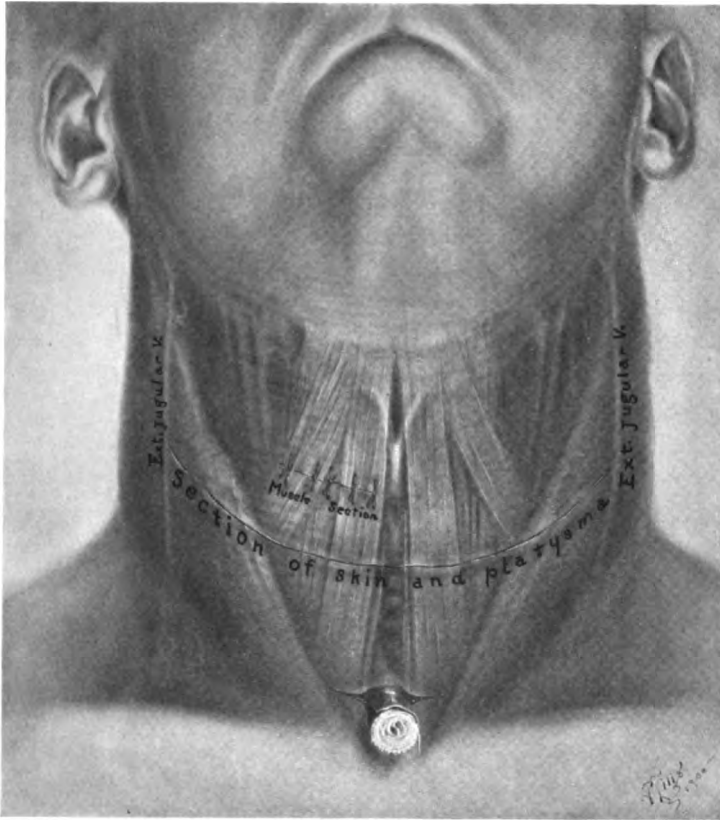


Fig. 141.—Muscle section higher than skin incision. Stab drainage.

development is only sufficient in most cases to convert a passive, helpless imbecile into an active, restless, and destructive idiot.

HYPOTHYROIDISM

The loss of the function of the gland seems to be the cause of more serious consequences in the young than in those who have reached

their complete development. Young adults who lose their entire thyroids will retrograde in intelligence, while the older individuals frequently develop myxedema, in which we have the myxedematous condition of the skin and subcutaneous tissues, dry skin, loss of glandular activity, loss of hair, and mental dullness. Apparently these cases are often overlooked unless well developed. The thyroid increases in size commonly at puberty and in the later months of pregnancy. Such enlargement usually subsides after a period. Oliphant Nicholson, of Edinburgh, speaks of the enlargement of the thyroid during pregnancy, and of the fact, as shown by Lange, that those who do not have such enlargement have an increased tendency to albuminuria and eclampsia. Kocher reports 70 per cent. of cachexias in 34 cases of total excision. Garrè reports 50 per cent. in 67 cases. Billroth had 52 cases develop tetany, with 9 deaths, and 11 developed cachexia. The London myxedema committee only found 24 per cent. in 224 cases of total excision. Considering the remarkable conditions which occur from a loss of the secretion of the thyroid, we are not surprised at the serious derangements from an oversecretion or an abnormal secretion.

EXOPHTHALMIC GOITER

In 1835 Graves, and five years later Basedow more thoroughly, described the disease known by their names, or by the term exophthalmic goiter. These conditions may be described by various writers in a somewhat different way, yet they all undoubtedly mean the same condition which is characterized by an excess of the activity of the gland. A better and more expressive term is hyperthyroidism. This condition occurs much more frequently in women than in men, and the greater number of patients are between twenty and forty years of age. It is not markedly hereditary and, while shock may be a contributing factor, it is difficult to elicit a probable cause in the majority of cases.

There are several symptoms in exophthalmic goiter which may occur in other conditions, yet, alone or associated, they lead the diagnostician to consider the possibility of exophthalmic goiter.

These symptoms are the enlargement of the thyroid, tachycardia, exophthalmos, muscular tremor, and general nervousness. The gland is usually enlarged, but may be palpable only in exceptional cases.

With the exophthalmos may occur von Graefe's symptom, the lagging behind of the upper lid in looking down, or Stellwag's sign, the retraction of the upper lid. Möbius described an occasional insufficient accommodation without diplopia. Exophthalmos may be absent in 20 per cent. of the cases. The heart action may vary from 90 to 180 a minute, a case of medium severity being about 120 to 140. Systolic murmurs are not uncommon. Muscle tremor is easily elicited even in mild cases by having the hand extended, fingers spread, palm down.

Associated symptoms are excessive perspiration, occasional rise of temperature, and digestive disturbances, chief of which are vomiting and failure to assimilate. Attacks of sudden diarrhea are not unusual. The onset of the disease may be rapid, or it may be over an extended period of time before being noticed. Many medical men still consider the disease to be a probable intestinal toxemia and look on the goiter as a coincidence, although all of the symptoms may be produced in healthy individuals by feeding thyroid, and even exophthalmos is now recorded as occurring following the administration of dried thyroid for obesity. The gland in a typical case usually presents the true hypertrophy, a wonderful increase in cell activity, the cell areas in the vesicles greatly increased in layers and by infolding. The cell form also changes in shape. The gland is dry and hard after removal as compared with the ordinary juicy colloid or adenomatous condition. The association of enlarged thymus in these cases is not definitely understood.

In our work at St. Mary's Hospital we have operated on exophthalmic goiters which were hardly palpable and have been surprised at the increased size of the gland over the normal when exposed. After all it is a question of increased secretion, absorption, and delivery by the lymphatics, not necessarily the retention and development of a tumor. If the exophthalmic gland was

no larger than normal, it would be many times more active. It is a question if the failure of lymph absorbents in certain areas may not, following hemorrhage or increased secretion, play a part in the production of some types of cysts. Exophthalmic goiter may occasionally develop in a case of goiter of long standing, and then there are diffuse areas of hypertrophy in the general tumor. The best classification of the exophthalmic type is: (1) vascular; (2) hypertrophic; (3) hyperthyroidism developing on previously existing goiter.

A fibroid condition of the gland may follow recovery from exophthalmic goiter, and the consequent loss of function later may cause myxedema. Ord and Mackenzie tabulated 56 medical cases of exophthalmic goiter which had lasted five years or had been fatal. There were 10 recoveries, 11 made incomplete recovery, in 13 there was considerable improvement, 4 were unchanged, and 14 (25 per cent.) were fatal. Other observers make more favorable reports.

With the general hygienic and therapeutic treatment of exophthalmic goiter we like the action of belladonna. We also make use of the x-ray. From its known action on the lymphatics and the glands it exerts a favorable effect on the over-activity of the gland in exophthalmic goiter, and in some cases seemingly develops something of a capsule and partially changes the character of the tumor. While its effect may not be permanent, it is a valuable adjunct in preparing advanced cases for surgical procedure. We have had no personal experience with the use of serum from thyroidectomized animals or milk from thyroidless goats. The cases and reports we have seen have given conflicting and not convincing evidence. J. Rodgers, of New York, is now experimenting with a thyroid serum which it is claimed is especially valuable in exophthalmic goiter. It is possible that much may yet come from auto-toxic serum treatment.

There is a type of thyroid, usually enlarged throughout the whole gland, appearing at about puberty and during the succeeding ten years, which Bloodgood calls simple goiter. In these cases dilated acini are filled with comparatively normal colloid. Similar con-

ditions often occur in pregnancy. In most of them the tumor disappears without treatment. Obstinate cases can be cured by some external application or treatment with iodine or organotherapy. In fact, it is reported (Bull's system) that Kocher claims that 90 per cent. of all goiters can be so improved by medical treatment as to render operation unnecessary.

Typical exophthalmic goiter may also exist as a symmetric enlargement. The irregular enlargement may be adenomata, cysts, or unevenly developed colloid goiter. Malignant disease in the thyroid also occurs in irregular enlargements, and Bloodgood states truly that when the disease has progressed so far that a differential diagnosis from benign tumor is possible, it is also probable that it is too far advanced to cure. For patients with irregular nodular tumors early operation should be advised. Sarcomas may be more uniform in appearance and cystic. Most of the bulging tumors, evenly rounded and covering the front of the neck, are the cystic or colloid-cystic type, with a heavy capsule, in which may be a thinned-out layer of the remains of the gland.

In some cases pressure atrophy seems to have destroyed all the gland, yet, as complete removal of these encapsulated masses or cysts does not often cause myxedema, it is probable that the system becomes accustomed to the very gradual withdrawal of the thyroid secretion. In three cases we have removed all of such encapsulated growths without cachexia, although it is possible that accessory thyroids were carrying on the function. One of the three was a large single cyst, the other two were cystic colloid, one measuring 22 and the other 19 inches across the tumor from one side of the neck to the other.

Loss of voice from tumor pressure occurs more often in malignant than in other tumors. The adenomatous growths, fetal and cystic, are common and represent a species of goiter frequently found in children and young adults. Cysts may follow hemorrhage, but more commonly they develop from adenoma and colloid degeneration. Echinococcus is infrequent, but must be considered. The necessity of a second operation on goiter is rare, according to Bergeat, being required in only 12 cases out of 600.

Wolff states that when one-half of the gland has been excised for hypertrophic goiter, the remaining half always diminishes. This is confirmed by Reverdin, Kocher, Poncet, and Wölfler. It has also been our experience. We do not believe in the semi-surgical treatment of goiter, that is, the injection, puncture, and drainage methods, which are nearly as dangerous as radical operative measures. Exothyreopexy or open displacement of goiter, Jaboulay's method, is merely mentioned.

The Relief of Exophthalmic Goiter.—The removal of the cervical sympathetic ganglia, as advocated by Abadie and Edwards and popularized by Jonnesco and Jaboulay, we have not considered to be as effective as the operation upon the diseased organ itself. Rehn's report makes it less than half as favorable. Surgeons do not seem to appreciate the effect of this operation and the ligation of arteries, also the experimental work on the parathyroids, in destroying the lymph-channels which drain the thyroid. Division of the isthmus for the relief of pressure is not effective, as the pressure is on the sides of the trachea and not on the top, except in cancer.

During the past seventeen years we have operated on 300 thyroids, with 11 deaths. Of these, 110 were for exophthalmic goiter, with 9 deaths in all, and but 2 in the last 64 cases. Two deaths in the early work were from accepting almost moribund cases as surgical risks. Among the remaining operations, representing cysts, colloids, adenomata, and parenchymatous, including 9 malignant tumors, there were but 2 deaths, one on the eighth day from pneumonia, the other from tracheal collapse following removal of carcinoma. One case was a large lingual thyroid, 3 were tumors of the pyramidal lobes, 2 only were accessory thyroids in the superior line of inversion, 2 were incisions and drainage for acute inflammatory conditions, 2 were for sarcoma.

We have been much pleased with the results of surgery in exophthalmic goiter. Of those who survive the operation, 50 per cent. make an early recovery, 25 per cent. improve from the main symptoms within several months, and 25 per cent., while greatly improved, have occasional temporary relapses of the tachycardia

and tremor. The exophthalmos is often one of the last symptoms to disappear.

Anesthetic.—The choice of an anesthetic is more often determined by the idiosyncrasy of the operator than by the necessity of the case. There were 13 operations made with cocain infiltration. Of these 3 were completed with chloroform. While there are occasional cases in which local anesthesia may be necessary, we have noticed but little difference in the shock or general condition of the cases from the anesthetic employed. We now use ether anesthesia, preceded twenty minutes by hypodermic of $\frac{1}{4}$ gr. of morphin and $\frac{1}{120}$ gr. atropin. The table is placed in an elevated slanting position with the head up (reverse Trendelenburg). The tumor is rendered prominent by a roll beneath the neck if it does not interfere with respiration.

Operation.—We prefer the collar or transverse incision. In tumors of medium size this crosses the center of the tumor; in larger tumors it crosses the upper third and the lower flap is split vertically to the sternum if necessary.

The incision is through skin and platysma muscle, the flap being raised to expose freely the muscles covering the gland, namely, the sternohyoid and thyroid, the inner portions of the sternomastoid and omohyoid. In medium-sized growths muscle separation will permit of the delivery of the tumor. The muscle section of the sternohyoid and thyroid group, if made, should be near their upper attachment so as not to interfere with their nerve-supply and also to break the line of scar formation from that part of the skin. After the removal of the gland, the severed muscles are carefully united by suture. The upper section also permits of early ligation of the superior thyroid artery, which is the key to the situation.

The more firm and rounded tumors, with strong capsules, can be readily enucleated after incising the capsule and penetrating the gland tissue to the cyst. We usually loosen the gland from the outside of the capsule first. On viewing the tumor, the true capsule has the luster and appearance of peritoneum. If one is not sure, incise between the vessels. Should hemorrhage be severe, lifting

up the tumor by its capsule will reduce the bleeding until sutures can be placed for its control. In parenchymatous and colloid tumors we make extirpation of one lobe and the isthmus. After exposing it the upper pole is elevated and the superior thyroid artery is cut between the ligatures. The lateral veins are clamped and cut, the lower pole is elevated into the wound, incision is made along the outer posterior border, and the capsule is brushed off with gauze to the median line. As a rule, the inferior thyroid is now ligated close to the tumor as the capsule is brushed back. This leaves the nerve behind and usually out of sight. The isthmus is clamped and closed by suture. If the enucleation method for adenoma and cysts leaves a badly torn lobe, it can be removed. Sometimes extirpation of one lobe is made and enucleation of cystic masses is done on the opposite side, after the method of Porta, Billroth, and Socin. The resection method of Mikulicz was only employed in one case, but with good result. The ligation of the thyroid arteries as a method was not practised. We avoid rough handling of the portion of gland to be left.

Should there be a large area of cut gland exposed, it is burned over with carbolic acid, followed by alcohol, or often Harrington's No. 9 solution is applied over the cut tissues to close the lymph absorbents and favor drainage. If there has been but little traumatism, we do not drain. Large incisions and large cavities we drain temporarily. All exophthalmic cases are drained as freely as the most septic wound.

These cases absorb some wound secretion containing colloid, causing rise in temperature and increase of pulse the next day. To delay absorption, especially in exophthalmic goiter, patients are given large quantities of salines by the bowel directly after the operation and for the first two to four days. If not retained by the bowel, they are given by subcutaneous administration.

The wound is closed by subcuticular suture, great pains being taken to unite the platysma to prevent spreading of the scar.

GOITER: ITS SURGICAL TREATMENT BASED ON FOUR HUNDRED AND SEVENTY- FIVE CASES *

By CHARLES H. MAYO

The thyroid gland shows very early in the development of the embryo. It is formed from three areas or buds, two lateral and one median. The median bud develops between the two halves of the tongue, and invaginates, extending down the neck as a tube—the thyroglossal duct. The fifth week the developing hyoid bone crosses the line of the duct. The upper portion obliterates, leaving an opening at the back of the tongue—the foramen cæcum. The lower portion forms the upper poles, isthmus, and also pyramidal lobe, when it is present. The seventh week sees the portions united with the lower poles, which develop from lateral buds in the fourth branchial cleft. At times the median portion does not descend, but remains in the tongue, developing a tumor known as a lingual thyroid. In the vertebrates the union of the various sections of the thyroid does not occur, and this, to some extent, is not an infrequent anomaly in man.

The united gland is somewhat the shape of a horseshoe, the concave border being up. It rests upon the front and sides of the trachea, to which it is firmly attached. The thyroid is inclosed by a fibrous capsule, which also aids in fixing the organ to the thyroid cartilage and tracheal rings. The capsule which covers the gland divides behind in such a manner that it not only covers the gland posteriorly, but also passes behind the esophagus between esophagus and trachea, to unite with similar structures upon the opposite

* Address in Surgery Delivered at the fifty-seventh annual session of the Illinois State Medical Society, May 21-23, 1907. (Reprinted from "Illinois Medical Journal," Oct., 1907.)

side. With such encapsulation we can readily see how the growth of the gland or the development of tumors within its tissue may cause serious pressure and distortion of the structures in immediate relation to it. The weight of the gland in the healthy adult is from 1 to 1½ ounces.

Accessory thyroids are also seen at times in the lines of the original areas of development. The thymus gland is formed from buds in the third branchial groove and passes downward in development to rest beneath the sternal notch.

The parathyroids discovered by Sandström in 1880 were supposed to be accessory thyroids until 1897, when it was shown that they were most important structures, having a separate function from the thyroid and seemingly to control to a great extent the nervous system. In later life they are apparently more important than the thyroid, as their removal causes death from tetany. The loss of the thyroid can be, to a great extent, supplied by feeding the gland, but feeding parathyroid is not as successful for tetany.

The function of the thyroid is a complex one. Among the various functions of the gland are its dilating effects upon the capillaries. In overdoses the metabolism of the body is affected by causing a loss of weight. In the obese it is a remedy to reduce overweight. Overdosage causes warmth of the skin, redness, and excessive sweating. Tachycardia is developed also from overfeeding of the gland secretion, one cause being from the large proportion of blood in the capillaries.

Hypothyroidism or loss of function of the gland, the opposite condition from hyperthyroidism as occurring in exophthalmic goiter, we see in myxedema, in which the opposite conditions also prevail; harsh, dry, thick skin with open pores, development of fatty deposits in pads over shoulders and clavicles, broadening and change of facial condition. General dullness or sluggishness of intellect and increase of weight are common.

A child born without a healthy thyroid fails to develop properly either mentally or physically. The secretion of the suprarenal capsule apparently serves to constrict all capillary growth and supply to the brain cortex, as well as the rest of the body. Such

cretins often make wonderful progress from the transplanting of the thyroid tissue or from feeding the same.

The thyroglobulin of the thyroid is not destroyed by gastric juice or even by boiling in 10 per cent. sulphuric acid solution.

Simple goiter or thyrocele is a most common occurrence in girls at puberty. The development is seldom excessive and usually subsides without treatment unless there be an encapsulated growth in the gland which becomes manifest from the increased circulation. These cases without an encapsulated tumor rarely require treatment and usually are of but a few months' or years' duration at most.

The second period of the development of goiter is during pregnancy. In fact, the enlargement of the gland is one of the favorable signs of pregnancy. Lange has shown that if the gland is not enlarged in the pregnant woman, she will have a tendency to albuminuria. This connection of the thyroid with the generative organs in the female is well marked, as diseased conditions of the generative organs are out of proportion common to those possessing goiter, while it is most common for women to have a temporary enlargement just previous to or during menstruation.

Some cases of sudden development of thyroid tumors, accompanied by great pressure and suffocating symptoms, are due to hemorrhage into the gland. Early incision is required.

Septic conditions affecting the thyroid are not common, but the pneumococcus is one of the organisms more commonly found and is transmitted by the blood-stream. Early free incision is demanded for relief. Still less common are seen tuberculosis, actinomycosis, or hydatid infection.

Those thyroids which present small nodules or median smooth and rounded tumors, or in which the natural contour of the gland is lost in the development of the rounded tumor, are practically always encapsulated tumors of fetal origin, or fetal rest tumors of embryonic thyroid tissue, or adenoma, some with cystic change.

Those goiters which develop more in accordance with the normal shape of the gland are more commonly known as diffused colloid, or diffuse adenomata, while those with larger retention, accumulations

of colloid with irregular contour are often called follicular goiter, the only capsule being that of the gland.

We employ the term hyperthyroidism because it expresses the true conditions far better than the terms more commonly used, viz., Graves' disease, Basedow's disease, Parry's disease, or exophthalmic goiter. To those of us who have been for many years on the firing-line, so to speak, of the surgical side of this subject it is extremely gratifying finally to see the disease placed upon a scientific basis of cause and effect.

For many years the varieties of treatment or the remedies used for Graves' disease were only exceeded in number by the numbers in use as cures for tic douloureux. These methods were rarely based upon other than empiric statements that they seemed good for or that they improved an individual case or two. The more recent attempts at relief by serum therapy appear to be based upon good reasoning, and when properly employed have in selected cases given satisfactory results.

In the past the operative treatment of goiters in general had been placed under a ban. It was considered an operation to be undertaken only under dire necessity, and naturally a last resort operation was accompanied by a high mortality. The main points impressed upon students were the reasons for not operating, and the patients were also informed that some hideous skin disease might follow or of a surety that they would become "foolish" should the goiter be removed and they survive the operation. Under these circumstances surgical treatment was advised only for patients who were exhausted by their disease or by the treatment they had received, and thus surgical aid was given only to those cases who persisted in failing in spite of all methods of treatment. Very often moribund cases were operated upon as a *dernier ressort*, and as usual in the progress of medicine, failures of this kind result either in abandonment or development of methods, improvements in diagnosis, choice of and preparation of patients, until to-day we have presented to us in a large series of cases the wonderfully low mortality of 2 or 3 per cent., with all cases relieved and most of them cured.

The statistics of the Kochers (who have long led the world in goiter surgery) report some two hundred and fifty cases of hyperthyroidism surgically treated. Other operators present a large number of cases, though smaller than the Kochers, and in considering these statistics I say again that it is extremely gratifying to know that we have accepted the fact that there is a similar change in the thyroid, either in part or in the whole of the gland in hyperthyroidism. Practically it is a "work" hypertrophy and cannot be distinguished from such condition when experimentally produced.

We have to consider four types of the disease, three regular and one pseudo:

First, the soft, vascular, pulsating thyroid with symptoms of hyperthyroidism.

Second, the hard, dry gland of hyperthyroidism, or usual type.

Third, the development of hyperthyroidism in those with pre-existing goiter in whom we find the changes of solid tissue, loss of colloid and vesicles filled with columnar and cuboidal cells in scattered areas, instead of a general change in the gland as in the first two types.

Fourth, pseudo-hyperthyroidism, in which we have those who by reason of the growth of an encapsulated adenoma in the gland suffer from excessive absorption of their own gland, which occurs at irregular intervals. Such cases may suffer from all the ordinary changes of hyperthyroidism for short periods, but they seldom develop exophthalmos.

The last-named variety is often overlooked in securing histories of goiterous individuals. Inasmuch as many cases of hyperthyroidism recover without treatment and others in spite of treatment, it is perfectly justifiable for physicians to institute treatment on any line, plan, or system which they believe proper. The mistake in the past has been to persist in the belief that some particular drug or treatment would eventually be successful, in spite of the downward progress of the patient, thus withholding surgical aid until, of necessity, the surgical mortality represents also in part what should properly be medicinal. On the other hand, the surgeon should not accept cases for operation until all the conditions

are as favorable as possible for the recovery of the patient. One of the great dangers of the operation is from myocardial change, usually shown by uneven tension and irregularity in the pulse. No patient should be operated upon whose pulse cannot be counted continuously because of uneven tension. Gastric crisis or diarrhea should also lead to postponement of operation. Ascites and edema of feet and hands are contraindications. All of the foregoing contraindications may, by suitable treatment, be overcome. The Kochers, in these cases, ligate one or more vessels of supply (under cocain) according to the case, reserving extirpation of the gland for a later period.

We have used belladonna extract with quinin internally, and in certain cases the x-ray is applied over the gland for as many times as is sufficient to discolor or even burn the skin. This treatment is given until the general condition improves and the operation is considered safe. The improvement under Röntgen ray may be most marked for a time, but is seldom a lasting one.

The anesthetic of choice is ether. Very rarely, indeed, do we find it necessary to use cocain. The etherization is preceded twenty to thirty minutes by a hypodermic of $\frac{1}{8}$ grain of morphin to allay the nervous restlessness and lessen the necessity for profound anesthesia. With the morphin is given $\frac{1}{120}$ grain of atropin to relieve the tracheal mucus which may come from ether, as well as the tracheal trauma.

The patient is placed in the reverse Trendelenburg posture, which by gravity tends to relieve the upper portion of the body of blood. The incision is the transverse, or collar, and includes skin and platysma myoid muscle. The dissection of these structures held together is carried down to the sternum and up to the top of the thyroid cartilage; the sternohyoid and thyroid muscles are separated in the midline to expose the gland. This separation may be sufficient in small tumors to permit the delivery of the gland, but often it will be necessary to cut across the group on the side removed to secure a safe working field. They are incised near the upper insertion so as to avoid injury to their nerve-supply, and resutured at the close of the operation. This also breaks the

continuous penetrating scar. The posterior capsule of the gland is brushed back with gauze as the gland is elevated. The superior thyroid artery is clamped and ligated as the upper pole is delivered, the inferior thyroid artery is ligated as it enters the gland through the capsule. At times this artery may be ligated further out, if seen in the dissection.

Preserving the posterior capsule tends to prevent injury to the parathyroids, which rest behind the intimate capsule of the gland, the injury or removal of which we know may cause tetany. This also preserves the recurrent laryngeal nerve. In several hundred operations for goiter we have seen but one very mild case of tetany of a temporary nature following this method of procedure. Great care must be exercised in ligating the superior thyroid, as a considerable proportion of deaths following an apparently successful operation are from hemorrhage. This hemorrhage is usually due to the including of some fibers of the omohyoid muscle in the ligature, which may be dislodged with movements of the neck. The isthmus is ligated, the wound area burned with carbolic acid and alcohol neutralization, or washed with Harrington's No. 9 solution, followed by free drainage through separate incision.

Harrington's solution is made up as follows:

	PARTS
Alcohol.....	640
Water.....	300
Hydrochloric acid.....	60
Bichlorid.....	.8

The patients are given freely large saline enemata under slight pressure. If not retained, they are given saline subcutaneously. This is repeated several times within the first thirty-six hours. Should excessive sweating occur, atropin is administered. If there is considerable serous discharge, hot boric acid dressings are applied over the front of the neck. The drains are left from two to four days, according to their apparent utility. The deaths which occur will usually be within twenty hours.

The general nervous restlessness and tremor subside to a remarkable degree within two days. The pulse may remain from 120 to 170 for two days, but drop suddenly on the third day about

20 to 30 beats, and is usually 80 to 110 beats within six days. The temperature may be elevated 2 to 5 degrees for two days following operation, when it drops with the pulse.

If exophthalmos is marked, it will not entirely disappear after operation, but will be greatly improved. Many cases only partially relieved of their symptoms are in no sense a discredit to the surgery, but merely show that not sufficient gland has been removed. These cases should be reoperated and more of the gland extirpated. We are greatly pleased with the result in four cases where this was done.

After operation these patients are seldom confined to the bed more than three days, and are commonly out of the hospital within a week. Practically all cases are improved over their former condition, and most of them cured. The mortality is constantly decreasing. There were four deaths in the first sixteen cases, three in the next thirty. We have made the last one hundred and fifty operations with two deaths.

In operating upon encapsulated tumors in the thyroid, we have the work well outlined for us by the conditions present. An encapsulated tumor of the gland is not supplying the system with thyroid secretions; therefore, its removal is an advantage to the system in preventing the destruction of real thyroid. The more nearly the surgeon can enucleate the growth without destroying or removing the thyroid, the more surely will there be only favorable results following the operation. Even enormous cysts should be enucleated, preserving what little thyroid there may still be in the capsule. Unless these tumors are very large and much traumatic serum is expected, drainage is not necessary.

Sarcoma and cancer are the most serious changes which occur in the gland. Such conditions are usually operated too late to give other than a high mortality and but few permanent cures. While the tracheal pressure is lateral in benign growths, we have noticed that it is the anterior rings which are softened by malignancy.

The mortality from thyroidectomy in benign tumors is very low, practically being accidental, as from pneumonia, hemorrhage, or sepsis.

THE PATHOLOGIC CHANGES IN THE THYROID GLAND, AS RELATED TO THE VARYING SYMPTOMS IN GRAVES' DISEASE; BASED ON THE PATHOLOGIC FINDINGS IN TWO HUNDRED AND NINETY-FOUR CASES *

BY LOUIS B. WILSON

The material for the following study was obtained from operations and autopsies on cases of Graves' disease (hyperthyroidism, exophthalmic goiter) in St. Mary's Hospital, Rochester, Minnesota, from March 3, 1898, to May 10, 1908.† The material in two of the cases was obtained at autopsy on patients dying of hyperthyroidism without having been operated upon. These autopsies were made within two hours of the death of the patient. All of the other material consisted of glands removed by Dr. C. H. Mayo.‡ Thirty-five of the cases were operated upon prior to the reorganization of the laboratory, January 1, 1905. When this study was begun, there was not sufficient data at hand from which to make a complete pathologic analysis of these thirty-five cases. No report however, has been previously made on their pathology, and I desire, therefore, to place them now on record as fully as the data will permit, although they will not be considered in estimating the percentages of the pathologic groups of the cases studied in full detail.

This series consists of: (A) Eleven cases in young females whose symptoms had existed without remission or abatement from two months to two years, and who at the time of examination presented

* Reprinted from "The American Journal of the Medical Sciences," Dec., 1908.

† To avoid future confusion Professor James Ewing authorizes me to state that the 40 cases reported by him in the "New York Medical Journal," 1906, lxxxiv, 1061, 1114, were exclusive of the cases in this series, although he had also studied sections from a number of my cases.

‡ This series does not include 13 cases operated on by Dr. C. H. Mayo in other hospitals, since no material from these cases was obtained in our laboratory.

all the classic symptoms of Graves' disease in a severe form. The pathologic diagnosis on all of these cases was noted at the time as "typical exophthalmic goiter." (B) Nine cases in females whose symptoms had existed from one to eleven years, but all of whom were better at the time of examination than they had been at some previous period. In all of these cases the pathologic report is either "typical exophthalmic goiter," or "exophthalmic goiter with colloid." (C) Fourteen cases in females whose symptoms had been present from three to thirty years, or from three months to one year following a previous long period of non-symptomatic goiter, and at no time had shown symptoms of more than moderate severity. The pathologic report on these cases is "colloid adenoma."

With the reorganization of the laboratory, January 1, 1905, with a larger staff and increased facilities, it became possible to take care of the pathologic material to better advantage. Since that time all specimens are brought immediately from the operating room to the laboratory, where they are examined fresh and then placed in fixatives, usually within ten minutes after they are removed from the patients. Blocks of tissue from each are fixed in 10 per cent. formalin, absolute alcohol, Zenker's fluid, and Flemming's chromosmic mixture. The remainder of the specimen is then photographed and preserved by Kaiserling's method.* Microscopic preparations are made of the fresh material frozen and stained with polychrome methylene-blue, by the author's method,† and also of the formalin-fixed material, frozen and stained with hematoxylin-eosin. From the examination of these two preparations the initial histologic record is made on the history sheets. When the final study was begun, material from the various fixatives was sectioned by the paraffin method and stained with hematoxylin-eosin, Heidenhain's iron hematoxylin, and Mallory's methylene-blue-cosin. The histology of each case was then care-

* Some of the gross specimens have been sent to other laboratories. This material was not on hand at the time of the present review. In these cases the detailed review of the gross anatomy was made from written descriptions and photographs of the fresh specimens.

† "Jour. Amer. Med. Assoc.," December 2, 1905.

GROUP A.

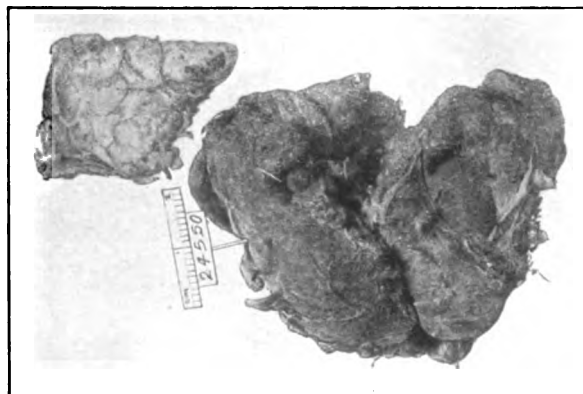


Fig. 142.—Photograph of the thyroid gland. X 1.

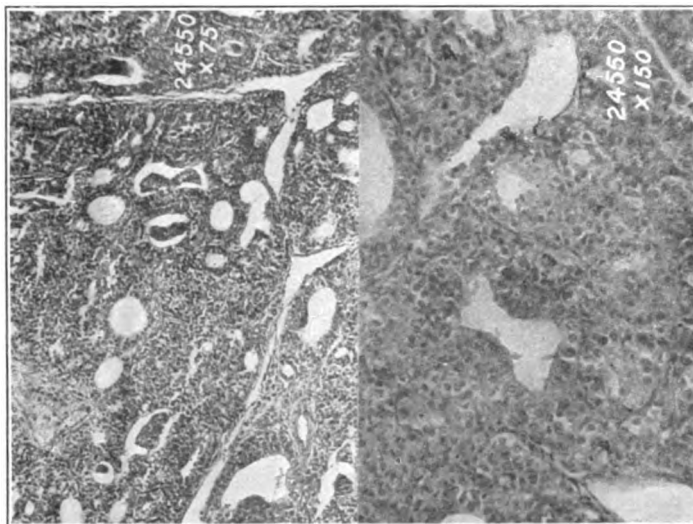


Fig. 143.—Photomicrographs.



Fig. 144.—Portrait before operation.

GROUP B.

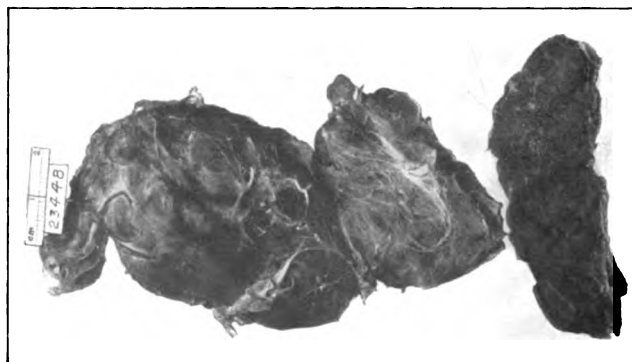


Fig. 145.—Photograph of the thyroid gland.
X 3.

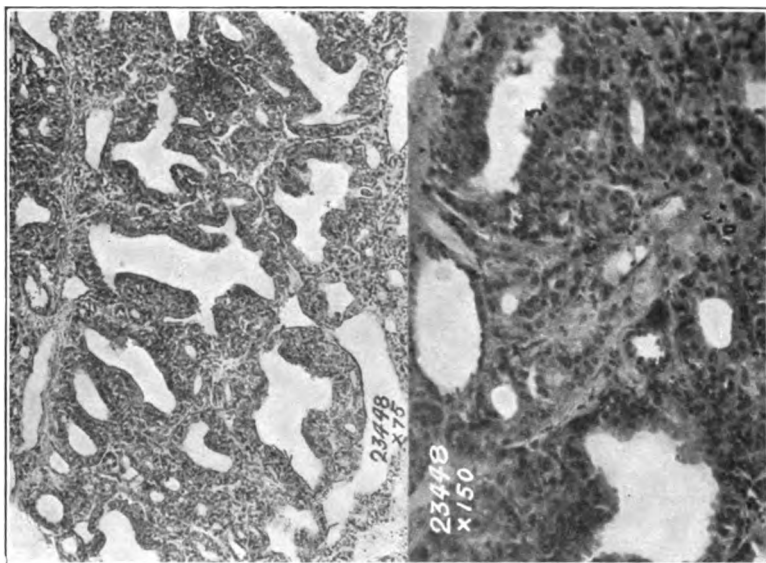


Fig. 146.—Photomicrographs.



Fig. 147.—Portrait before operation.

GROUP B.

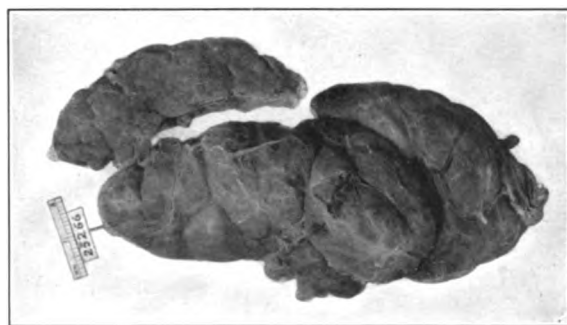


Fig. 148.—Photograph of the thyroid gland. $\times \frac{1}{2}$.

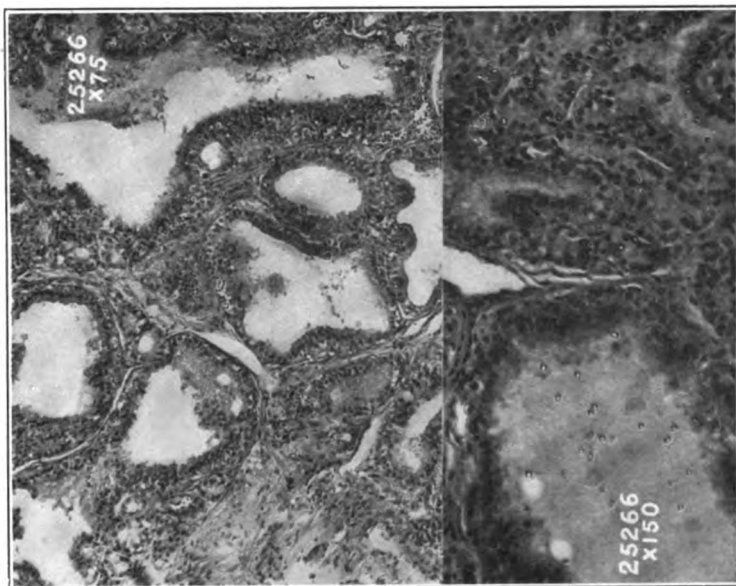


Fig. 149.—Photomicrographs.



Fig. 150.—Portrait before operation.

GROUP B.

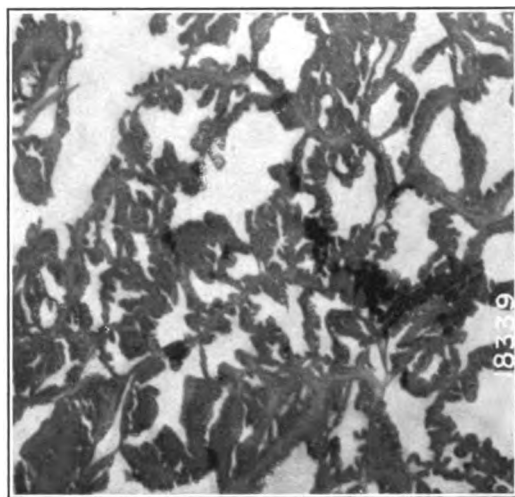


Fig. 152.—Photomicrograph.



Fig. 151.—Photograph of the thyroid gland. $\times 4$.



Fig. 153.—Portrait before operation.

GROUP B.

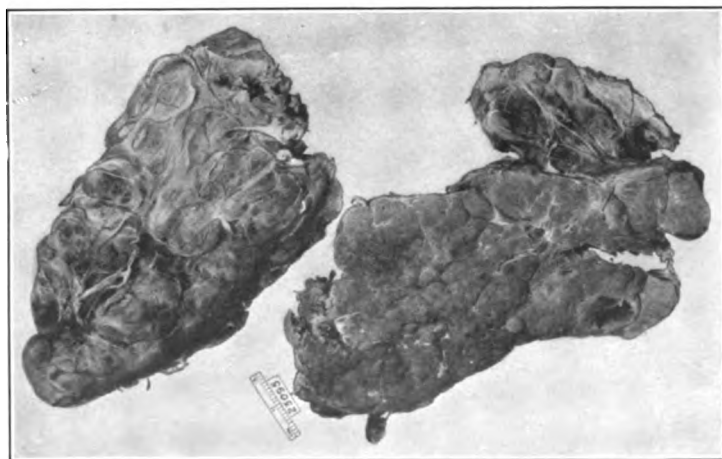


Fig. 154.—Photograph of the thyroid gland. $\times \frac{1}{2}$.

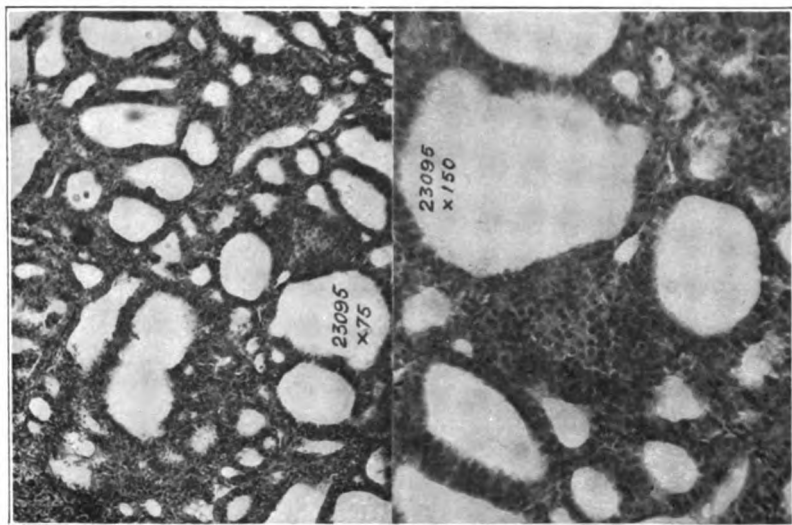


Fig. 155.—Photomicrographs.



Fig. 156.—Portrait before operation.

GROUP B.

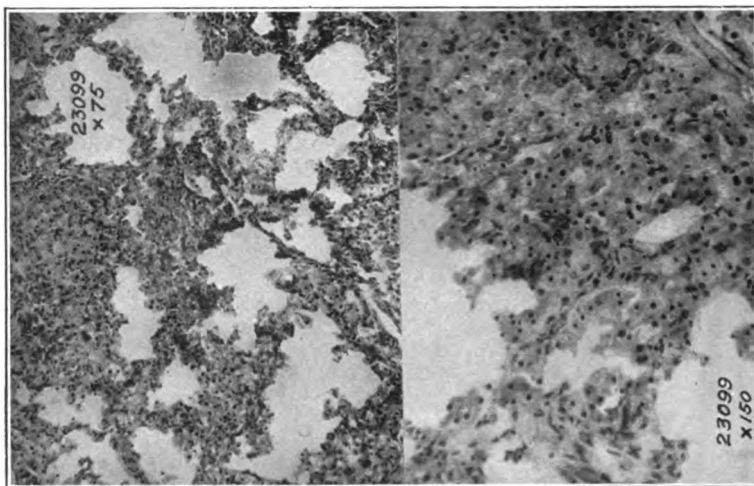


Fig. 158.—Photomicrographs.



Fig. 157.—Photograph of the thyroid gland. $\times \frac{1}{4}$.



Fig. 159.—Portrait before operation.

GROUP B.

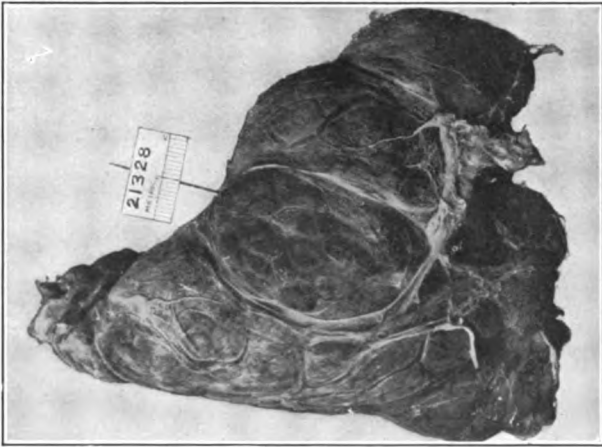


Fig. 160.—Photograph of the thyroid gland. $\times 2$.

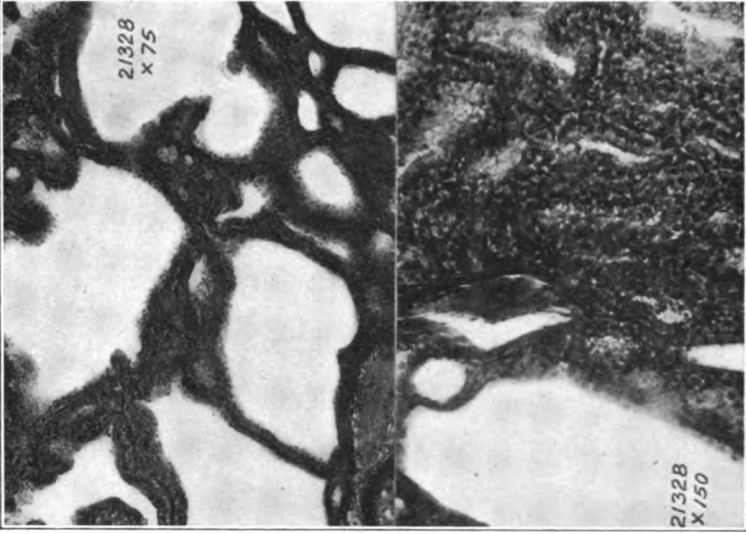


Fig. 161.—Photomicrographs.



Fig. 162.—Portrait before operation.

GROUP C.

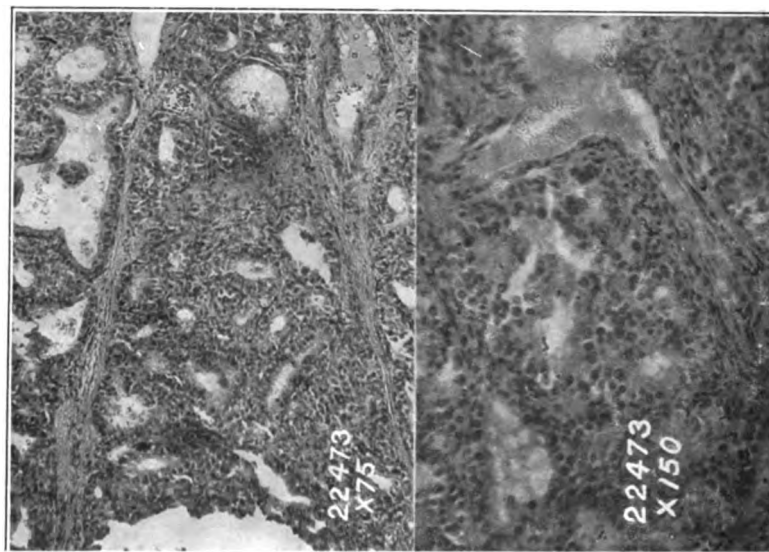


Fig. 164.—Photomicrographs.

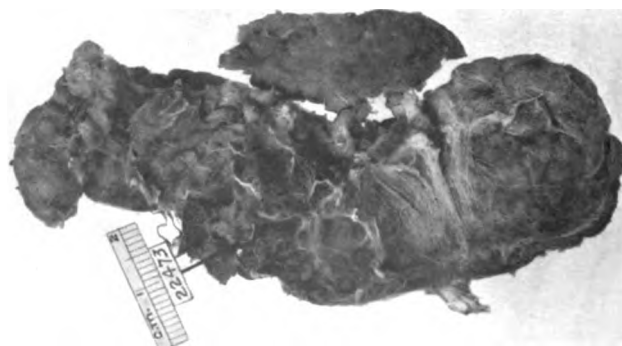


Fig. 163.—Photograph of the thyroid gland.
X 4



Fig. 165.—Portrait before operation.

GROUP C.

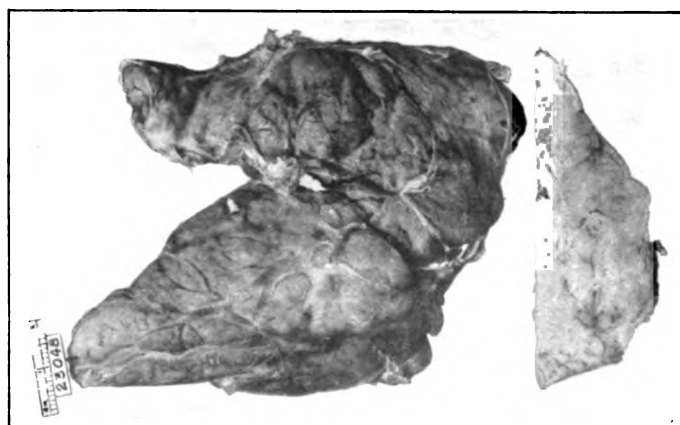


Fig. 166.—Photograph of the thyroid gland. X 2.

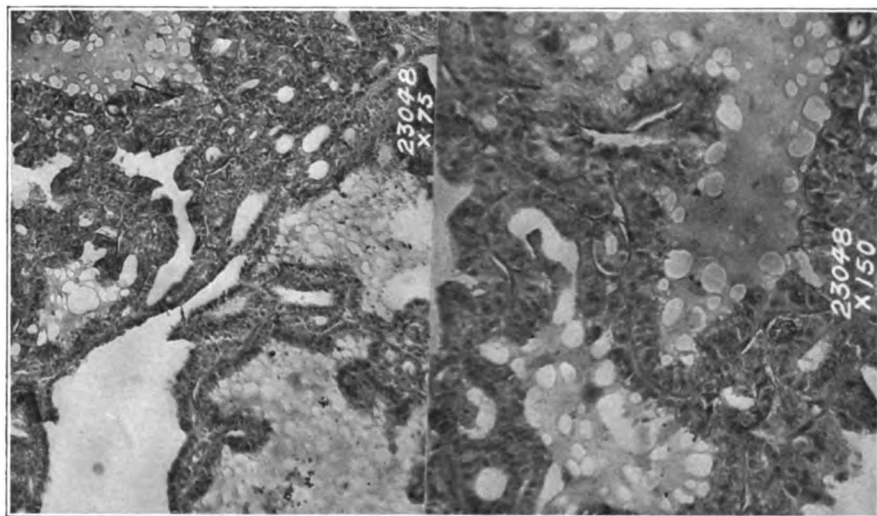


Fig. 167.—Photomicrographs.



Fig. 168.—Portrait before operation.

fully reviewed from all the preparations at hand, and notes made according to a formula compiled from the reports of previous observers.* As may be supposed, the detailed data from these studies are much too voluminous to report in any one paper, and it is only that portion of it which seems to be related to the clinical histories to which I wish now to call attention.

While this review was in progress every care was taken to exclude all knowledge of the clinical histories of the cases in order that there might be no clinical bias entering into the pathologic estimate. As the work proceeded it was found that certain pathologic pictures were frequently repeating themselves. When the examinations were completed, these pictures were found to represent cases constituting four large groups, and there was little trouble in arranging the remainder of the cases so as to form connecting groups between the large and more striking ones. The following cases presented from the pathologic standpoint will illustrate these groups with sufficient accuracy for the succeeding clinical comparisons:

PATHOLOGIC GROUP A.—Case No. 24,550 (Fig. 142).—This specimen is a gland, the removed portion of which weighs 30 grams fresh. Grossly it is hard and nodular. The cut surface is particularly dry and granular throughout. There is considerable increased vascularity, the veins being swollen and thin-walled. Microscopically (Fig. 143) the stroma bands are found considerably thickened and extensively infiltrated with leukocytes. The alveoli are from 0.06 to 0.2 mm. in diameter. There are very few papillary projections into the alveoli. The parenchyma cells are increased in number in certain alveoli, both in the single layers and by reduplication of the layers. The parenchyma cells are columnar, about 10 microns in diameter, have swollen nuclei, granular protoplasm, and show in many areas mitotic figures. There is apparently no exfoliation of the parenchyma cells. The secretion is small in amount and non-eosin-staining. From the pathologic standpoint the symptoms, if any, in such a case, should be those of very early, mild hyperthyroidism. The clinical history shows that the gland is from a female (Fig. 144), aged twenty years,

* It is proper to state that as a preliminary study about 300 simple goiters were examined and, as occasion arose during the progress of the work on the Graves' goiters, the former were again reviewed and compared with the latter.

who has had a slight symptomless enlargement of the thyroid for one year, and moderate Graves' symptoms for the last two months, that is, tachycardia, fine tremor, sweating, etc.

This case is representative of a very small group (Group A) of operated cases, there being but three patients (10 per cent.) in our entire list, although a number of other patients, of parallel clinical characteristics who have presented themselves for examination, would probably have yielded glands of similar pathology had they been operated upon.

The characteristics of this group may be stated as follows: (1) Small intra-alveolar parenchyma increase. Shown by: (a) Size of the gland; (b) increased number of cells in a single layer; (c) reduplication of layers. (2) Small amount of thin secretion. Shown by: (a) Dryness of the fresh section; (b) small amount of secretion in stained sections. This is non-eosin-staining.

PATHOLOGIC GROUP B.—Case No. 23,448 (Fig. 145).—This is a 53-gram gland, hard and nodular externally, granular, with a slightly glairy cut surface. Histologically (Fig. 146) the sections show increased alveolar parenchyma, papillæ formation, and a large amount of non-staining secretion. Clinically (Fig. 147) the patient is a female, aged thirty-six years, who after three years' progressive Graves' disease, now shows severe symptoms, that is, nervousness, tachycardia, tremor, some diarrhea and vomiting, and exophthalmos.

Case No. 25,266 (Fig. 148).—This is a 60-gram gland of the same character grossly as the preceding. Histologically (Fig. 149) there is a large amount of intra-alveolar parenchyma increase, papillæ formation, and a large amount of thin secretion. Clinically (Fig. 150) the patient is a woman, aged twenty-eight years, with a history of two years of Graves' disease, and at present severe symptoms, that is, tachycardia, nervousness, tremor, profuse sweating, some diarrhea and vomiting, and exophthalmos.

Case No. 18,339 (Fig. 151).—This gland weighs 60 grams fresh, is hard and rigid, with a nodular outer surface. The veins are swollen, varicosed, and thin-walled. Histologically (Fig. 152) the section shows a picture almost parallel with that of the previous case, except that the alveoli here are larger and the papillary projections in them are numerous, while there is a large amount of

thin, non-eosin-staining secretion. Pathologically this case should be in the acute stage and severe in type. Clinically (Fig. 153) the patient is found to be a female, aged nineteen years, with Graves' symptoms for one year, and now of severe type, that is, nervousness, tremor, weakness, exophthalmos, and pulse 150.

Case No. 23,095 (Fig. 154).—This is a 95-gram gland, hard and nodular, and dry and granular on its fresh-cut surface. The large, irregular alveoli (Fig. 155) are lined with swollen parenchyma cells which have not begun to exfoliate. The secretion is fairly large in amount, thin, and feebly staining. A severe first period is indicated pathologically. Clinically (Fig. 156) the patient is a woman, aged twenty-five years, who, for two months, has had a progressive chain of symptoms of hyperthyroidism, that is, nervousness, tremor, palpitation, tachycardia, exophthalmos, diarrhea, and vomiting, and now would be considered a case of very severe grade.

Case No. 23,099 (Fig. 157).—This is a 120-gram gland, hard and nodular, with a granular, glairy cut surface, and swollen tortuous veins. Histologically (Fig. 158) there are large alveoli with great intra-alveolar parenchyma increase, papillæ formation, and a large amount of thin, non-staining secretion. Clinically (Fig. 159) the patient is a female, aged thirty-six years, who has had progressive symptoms of Graves' disease for three years. They are now of a very severe type, that is, tremor, palpitation, tachycardia, diarrhea and vomiting; exophthalmos for one year and a half.

Case No. 21,328 (Fig. 160).—This is a very large gland, weighing 223 grams fresh. It feels hard, has a nodular outer surface, and a glairy cut surface. The veins are swollen and tortuous; the walls of the large vessels are thin, and there are many small hemorrhages with marked hyperemia throughout the gland. The alveoli, papillary projections, parenchyma cells, etc., are parallel to those in the previous cases, as will be seen (Fig. 161). Pathologically this should be a severe acute case. Clinically (Fig. 162) the patient is a male, aged thirty-seven years, who has presented a set of symptoms of Graves' disease of gradually increasing severity for six years, and who is now in an extremely critical condition. There has been no remission of symptoms at any time in this case. His history shows he has lost 40 pounds in weight in the last six months previous to operation.

These six cases illustrate quite fully pathologic Group B. This

is the largest group in the series, containing one hundred and seventeen cases, or about 45 per cent. Clinically all of these cases, except eight, are to be found in the first, that is, acute, stage of the disease, and all of them, of two, three, or four degrees of severity; seven of the remaining eight cases had shown some remission of symptoms, and they are counted in our series of partial disagreements.

The characteristics of this group may be stated as follows: (1) Large intra-alveolar parenchyma increase. Shown by: (a) Size of the gland; (b) increased number of cells in a single layer; (c) reduplication of layers; (d) infolding of alveolar walls; (e) papillæ formation. (2) Large amount of thin secretion. Shown by: (a) "Glair" of fresh section; (b) large amount of secretion, which is non-eosin-staining in stained sections.

PATHOLOGIC GROUP C.—Case No. 22,473 (Fig. 163).—This is a 35-gram gland whose granular, glairy cut surface presents some alternating areas of gelatinous appearance. Histologically (Fig. 164) the large alveoli contain numerous papillary projections, but the columnar parenchyma cells are exfoliating in many areas. There is a large amount of secretion, much of which is non-staining, but some of which is stainable. Pathologically this case should show some remission over its previous symptoms. Clinically (Fig. 165) the patient is a woman, aged twenty-nine years, who for three years has shown symptoms of Graves' disease, which, although now of a severe type, are less severe than they have been previously.

Case No. 23,048 (Fig. 166).—This is a 45-gram gland, hard, nodular, with much of the cut surface granular, glairy, but in some areas gelatinous. Histologically (Fig. 167) there are large alveoli, great intra-alveolar parenchyma increase, papillæ formation, and a large amount of secretion, some of which is stainable and some unstainable. There is also considerable exfoliation of parenchyma and marked cytolysis in some areas. Clinically (Fig. 168) the patient is a female, aged thirty-seven years, who has had symptoms of Graves' disease for sixteen years. Although her present symptoms are now those of very severe hyperthyroidism they have been worse, and there have been numerous remissions during the period of her illness.

These cases illustrate pathologic Group C. Clinically this

group contains fifty-four of our cases, or about 21 per cent. These are almost all second-stage cases; that is, those showing more or less remission of previously severe symptoms, although even now they are of severe or very severe type.

The characteristics of this group may be stated as follows: (1) Large intra-alveolar parenchyma increase. Shown by: (a) Size of the gland; (b) increased number of cells in single layer; (c) reduplication of layers; (d) infolding of alveolar walls; (e) papillæ formation. (2) Large amount of thin secretion. Shown by: (a) "Glair" of fresh section; (b) large amount of secretion, most of which is non-eosin-staining, in stained sections. (3) Beginning degeneration. Shown by: (a) Denser staining of some of the secretion; (b) beginning exfoliation of the parenchyma.

PATHOLOGIC GROUP D.—Case No. 21,374 (Fig. 169).—This is a 200-gram goiter, hard and nodular externally, and with gelatinous cut surface. There is no markedly increased vascularity, while the stroma has materially increased. Histologically (Fig. 170) the alveoli are very large (0.6 to 1 mm.). There is almost complete exfoliation of the parenchyma cells, but the original character of the gland is definitely shown by well-preserved remains of papillæ in some of the alveoli. The secretion is very large in amount and well staining, being of the so-called "colloid" variety. If this represents a form of degeneration, the case should be one improved over its previous history. Clinically (Fig. 171) the patient is a woman, aged forty-four years, whose first Graves' symptoms developed about eight years ago. Although the condition of the heart makes the case still a severe one, yet the symptoms of hyperthyroidism are much reduced over what they were three years ago.

Case No. 21,756 (Fig. 172).—This is a gland weighing 81 grams, whose cut surface is gelatinous throughout. Histologically (Fig. 173) the large alveoli contain well-staining secretion filled with the remains of exfoliated cells, and showing, in only a few instances, papillary projections sufficiently well preserved for identification. Clinically (Fig. 174) the patient is a female, aged fifty-seven years, who, for two years, until three years ago, had marked Graves' symptoms. Her present symptoms, although mild, are sufficiently well marked for diagnosis, although not enough to warrant operative interference, were it not for the pressure symptoms caused by

GROUP D.

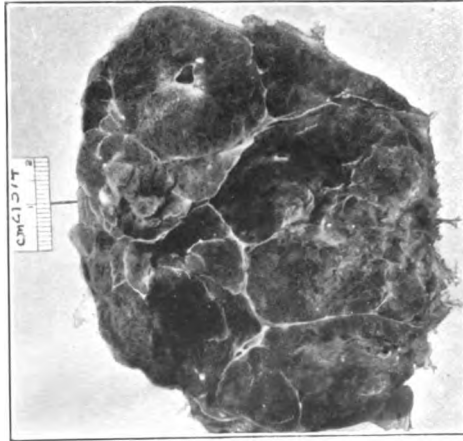


Fig. 169.—Photograph of the thyroid gland. $\times 1$.



Fig. 170.—Photomicrographs.



Fig. 171.—Portrait before operation.

GROUP D.

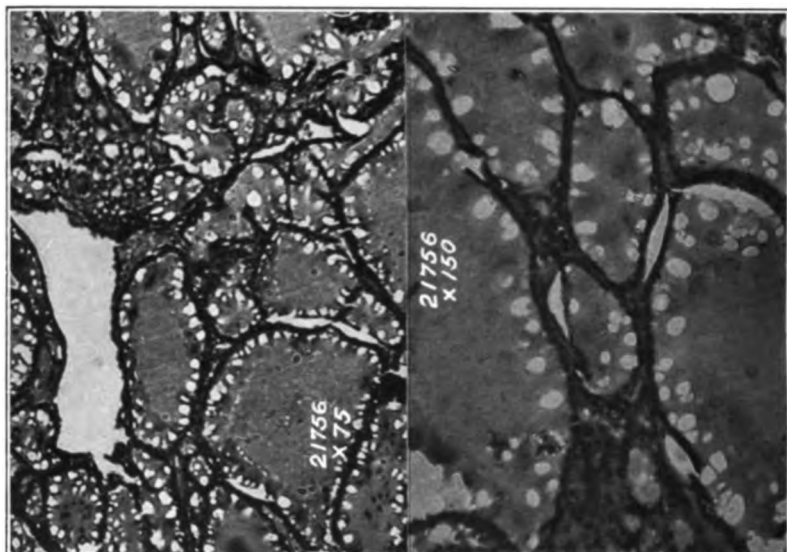


Fig. 173.—Photomicrographs.

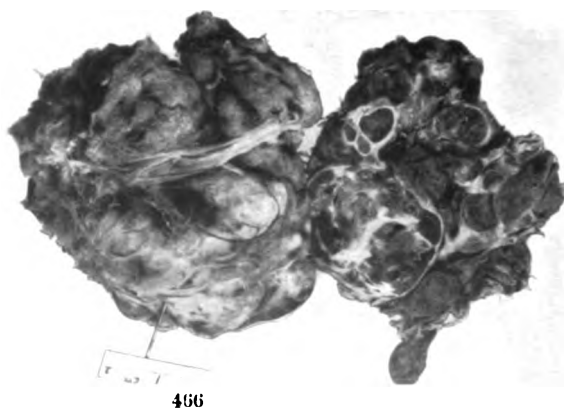


Fig. 172.—Photograph of the thyroid gland. $\times 3$.



Fig. 174.—Portrait before operation.

GROUP E.

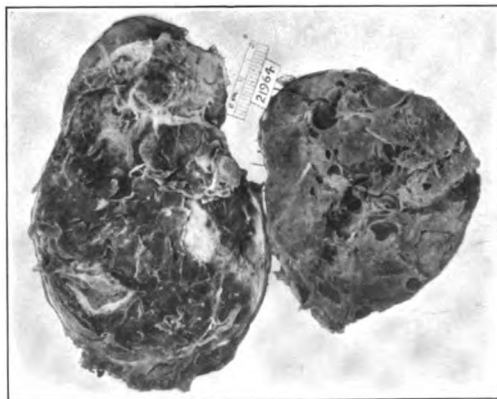


Fig. 175.—Photograph of the thyroid gland. X $\frac{1}{2}$.

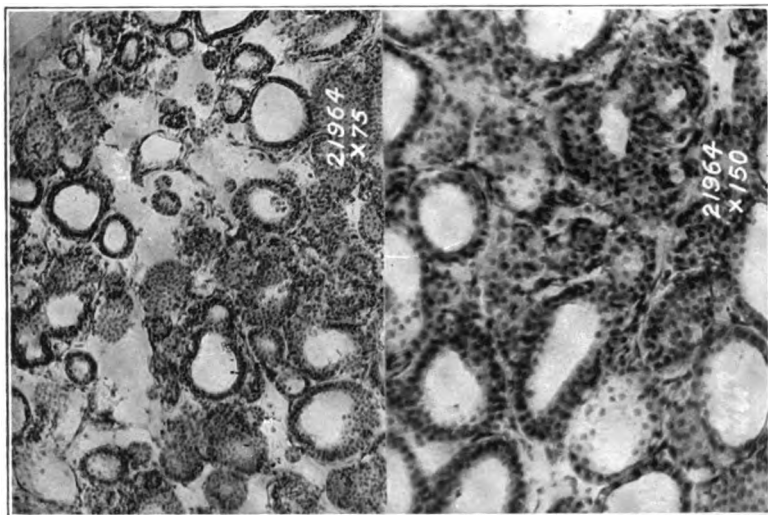


Fig. 176.—Photomicrographs.



Fig. 177.—Portrait before operation.

GROUP F.

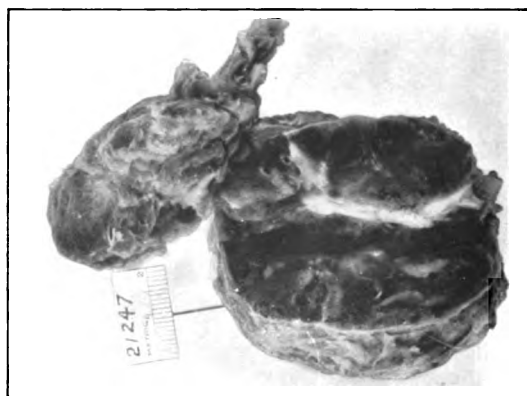


Fig. 178.—Photograph of the thyroid gland. $\times 1$.

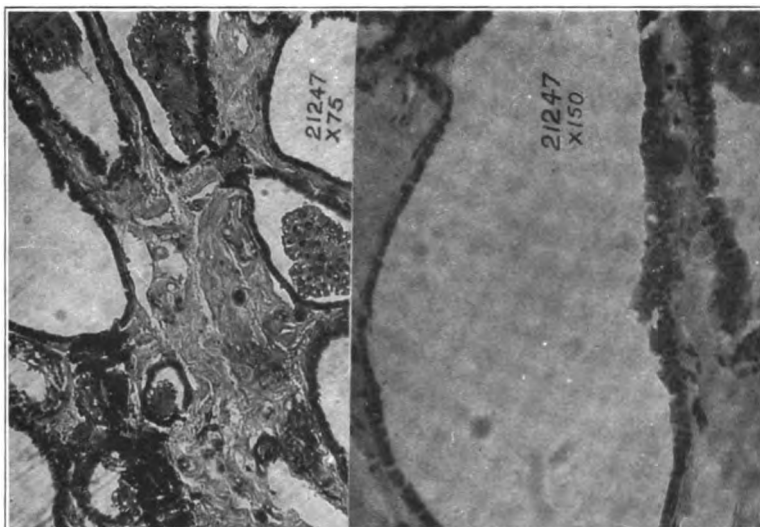


Fig. 179.—Photomicrographs.



Fig. 180.—Portrait before operation.

the large gland. This is a case of self-cured Graves' disease, with the exception of the rapid heart and choking sensations.

These cases represent pathologic Group D. There are thirty-four cases in this group, or 12 per cent. Clinically all of them are in the second or third clinical stages; that is, they show marked total improvement, or, at least, some cessation of the symptoms of acute hyperthyroidism. Many of them are still of two to four degrees severity.

The characteristics of this group may be stated as follows: (1) Old intra-alveolar parenchyma increase. Shown by: (a) Size of the gland; (b) remains of infolding; (c) remains of papillæ. (2) Large amount of thick secretion. Shown by: (a) Gelatinous appearance of fresh section; (b) large amount of secretion, most of which is eosin-staining, in stained sections. (3) Advanced degeneration. Shown by: (a) dense staining of most of the secretion; (b) more or less complete exfoliation of the parenchyma.

PATHOLOGIC GROUP E.—Case No. 21,964 (Fig. 175).—This is an 88-gram gland, hard and nodular externally, and showing small cysts on its cut surface, which is otherwise dry and rather solid looking. Histologically (Fig. 176) the alveoli are found to be quite small (from 0.05 to 0.08). This is a typical proliferating adenoma of fetal type. There is only a small amount of thin, non-stainable secretion. Clinically (Fig. 177) the patient is a female, aged thirty-three years, who had a slowly developing gland for six years, with Graves' symptoms coming on so slowly that they caused no disturbance until two years ago, and even now they are only moderately severe.

This case represents the first pathologic group (Group E) of the second series. The first series, Groups A, B, C, and D, are essentially an intra-alveolar form of parenchyma increase, while these show multi-alveolar parenchyma increase; that is, they resemble adenomas in type. There are but eleven cases, 4 per cent., of this type in our series. Clinically all of them are mild, continuous cases of Graves' disease of from one to thirteen years' duration. All of them are of moderate severity, and were operated

upon, as much on account of pressure symptoms, as because of hyperthyroidism although the latter was sufficiently pronounced to render the diagnosis unmistakable.

The characteristics of this group may be stated as follows: (1) Small multi-alveolar parenchyma increase. Shown by: (a) Size of the gland; (b) recently formed alveoli. (2) Small amount of thin secretion. Shown by: (a) Dryness of fresh section; (b) small amount of secretion, which is non-eosin-staining, in stained sections.

PATHOLOGIC GROUP F.—Case No. 21,247 (Fig. 178).—This is a 70-gram gland which is rather soft, and on cross-section collapses readily, although it contains no definite cyst. Histologically (Fig. 179) the specimen is adenomatous in type, with considerable parenchyma increase and a large amount of non-stainable secretion. Clinically (Fig. 180) the patient is a woman, aged thirty-seven years, who for one year has had an enlarged thyroid, nervousness, profuse sweating, and fine tremor. She would be classed as in stage one, or mild, continuous, and of Grade 1 in severity.

This case represents pathologic Group F, which is the same as Group E except that the glands show a greater parenchyma increase and contain a larger amount of thin secretion in the alveoli. There are but five cases of this group, or 2 per cent., in our series.

The characteristics of this group may be stated as follows: (1) Large multi-alveolar parenchyma increase. Shown by: (a) Size of the gland; (b) recently formed alveoli. (2) Large amount of thin secretion. Shown by: (a) "Glair" of fresh secretion; (b) large amount of secretion, which is non-eosin-staining, in stained sections.

PATHOLOGIC GROUP G.—Case No. 21,804 (Fig. 181).—This is a 42-gram gland, gelatinous on its cut surface, and with rather large alveoli (Fig. 182) filled with stainable secretion and showing considerable exfoliation of its parenchyma. Clinically (Fig. 183) the patient is a female, aged twenty years, who has had mild Graves' symptoms for a year and one-half; that is, goiter, nervousness; pulse has been 180, is now 130; menstruation has not been disturbed. One year after her operation her return history shows her to be well.

GROUP G.



Fig. 181.—Photograph of the thyroid gland. X 1.

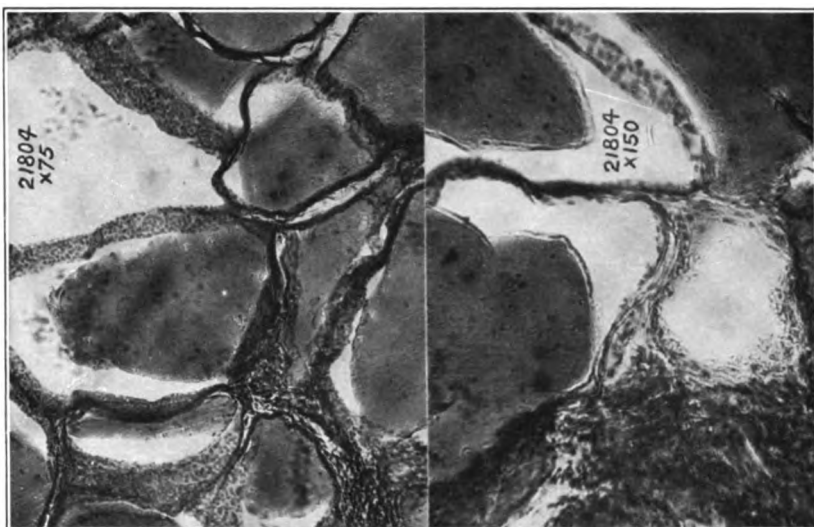


Fig. 182.—Photomicrographs.



Fig. 183.—Portrait before operation.

GROUP II.

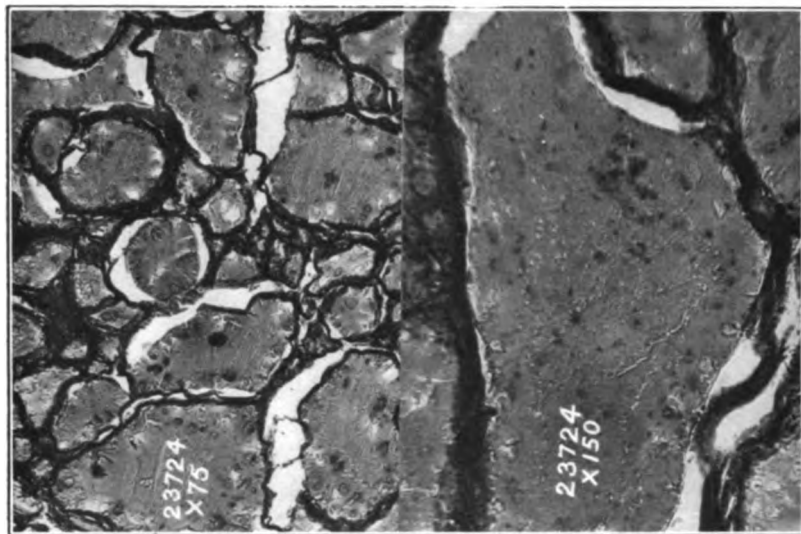


Fig. 185.—Photomicrographs

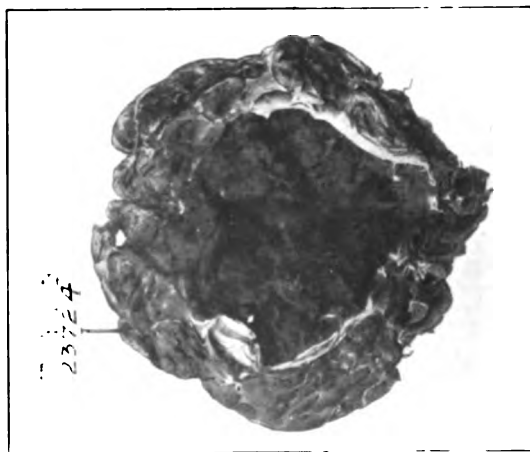


Fig. 184.—Photograph of the thyroid gland. X 1.



Fig. 186.—Portrait before operation.

This case represents pathologic Group G, of which there are eleven cases, or 4 per cent., in our series. All of these are mild, continuous, of but moderate severity (Grade 2).

The characteristics of this group may be stated as follows: (1) Large multi-alveolar parenchyma increase. Shown by: (a) Size of the gland; (b) recently formed alveoli. (2) Large amount of secretion. Shown by: (a) Large amount of secretion, most of which is non-eosin-staining, in stained sections. (3) Beginning degeneration. Shown by: (a) Denser staining of some of the secretion; (b) beginning exfoliation of the parenchyma.

PATHOLOGIC GROUP H.—Case No. 23,724 (Fig. 184).—This is a 55-gram gland whose cut surface is gelatinous and filled with cysts. Histologically (Fig. 185) the alveoli are large (from 0.2 to 0.5 mm. in diameter) and of adenomatous type. There is marked exfoliation in most areas. The secretion is large in amount and well stained. Pathologically this is an old adenomatous proliferation producing mild, exophthalmic symptoms. Clinically (Fig. 186) the case is a female, aged fifty-two years, who had had an old goiter for seventeen years. Within the last three years she has developed moderately severe symptoms of Graves' disease which have been at a standstill for the past year.

This group represents pathologic Group H. It contains twenty-four cases, or about 10 per cent. of the series. Clinically they are all mild, continuous, or first-stage cases, and none are of more than moderate severity (Grade 2).

The characteristics of this group may be stated as follows: (1) Old multi-alveolar parenchyma increase. Shown by: (a) Size of the gland; (b) sometimes scattered groups of recently formed alveoli. (2) Large amount of thick secretion. Shown by: (a) Gelatinous appearance of fresh section; (b) large amount of secretion, most of which is eosin-staining, in stained sections. (3) Advanced degeneration. Shown by: (a) Dense staining of most of the secretion; (b) more or less complete exfoliation of the parenchyma.

On the basis of the above pathologic grouping, which was made

originally without reference to clinical conditions and without knowledge of the clinical facts in any of the cases, I ventured a conjecture as to the probable clinical history in each case. Aside from the pathologic data this conjecture was based on the working hypothesis that the severity of the symptoms in Graves' disease is probably directly proportional to the amount of thyroid secretion absorbed from the glandular alveoli. The whole study was an attempt to determine, in as unbiased a manner as possible, whether or not any such definite relationship really exists between the varying pathologic changes in the thyroid gland and the varying symptoms in Graves' disease.

For finally determining the value of these conjectures the following method was adopted: Dr. H. S. Plummer, who had written the original office histories in the majority of the cases, kindly reviewed his own histories as well as those of the other clinicians, and grouped them as follows: Grade 1: Acute cases of (1) mild, (2) moderate, (3) severe, or (4) very severe degree. Grade 2: Cases which had been severe, but at the time of examination showing remission of symptoms. Grade 3: Cases of previously severe hyperthyroidism, but with symptoms now chiefly of severe vital-organ-lesion type (heart, nervous system, etc.) rather than hyperthyroidism. Grade 4: Mild, continuous cases, slowly developing.

When the clinical and pathologic classifications had been definitely made, the two were compared case by case. As a result an almost complete parallel was found to exist between the pathologic conjectures and the clinical facts in about 80 per cent. of the cases. In about 17 per cent. more the apparent disagreements were readily explicable on reviewing both the clinical and the pathologic data. In but six of these cases, or less than 3 per cent., there was a disagreement for which, as yet, we have been unable to find any positive explanation. In these six cases the pathology indicates a more severe type of the disease than is shown by the clinical histories.

Having found that the pathologic groups in our series of cases correspond with considerable accuracy to well-marked clinical groups, it is necessary to examine them a little more closely to determine, if possible, what this correspondence may indicate in

regard to the pathologic development. It will be noted that the groups are in two series: (1) Those essentially with increased parenchyma within alveoli, and (2) those with increased number of alveoli. Each series starts with a group, with but a small amount of parenchyma and secretion increase (A and E), proceeds to a group with a large amount of parenchyma and secretion increase (B and F), and thence to a group like the preceding, with but beginning degeneration (C and G), and terminates with a group characterized by more or less complete degeneration (D and H).

As suggested above, the clinical interpretation of this grouping is made on the following working hypothesis, which is merely an elaboration of Möbius' theory:

1. That the symptoms of Graves' disease are associated with increased absorption of an increased secretion of the thyroid gland.
2. That the more functioning parenchyma cells in the gland, the larger the amount of its secretion.
3. That the more fluid the secretion of the gland, the more readily will it be absorbed.
4. That the cells partly disintegrated and found embedded in the secretion in the alveoli with partially or wholly naked walls are mostly, if not entirely, desquamated epithelial cells.
5. That the increased concentration of the stained secretion by the absorption of its own fluid constituents, and by the desquamation of the alveolar epithelium, probably tends to reduce absorption from the gland as a whole.
6. That the dense, gelatinous, well-stainable secretion, the so-called "colloid," in any thyroid gland is not, probably, strictly speaking, a normal product, but the complement of the absorbed portion.
7. That when dense, basic-stained, colloid material fills the alveoli of the thyroid gland it probably should be regarded as evidence, not of present secretion, but of blocked absorption and parenchyma destruction.
8. When, therefore, we measure either histologically or chemically the relative colloid (globulin) content of the thyroid gland, we

should bear in mind that we are probably not determining factors which have actually caused the symptoms, but only their associated phenomena.

On such a basis a very simple hypothesis of the development of Graves' disease may be formulated as follows:

1. Following a metabolic, chemical, or extra-organismal irritant, thyroid parenchyma proliferates, over-functionates, and degenerates.

2. This process primarily resembles simple, adenomatous proliferation, or reminds one of adenopapilloma.

3. Either process may start in a gland not previously enlarged by retained secretion, or in one which is already distended with non-absorbed secretion.

4. The severity of the symptoms depends upon (a) the amount of absorbable secretion, and (b) the patient's ability to neutralize the secretion.

I would urge that, in making histologic examinations of the glands from cases of hyperthyroidism, the gland should be studied throughout, and that the statement of findings in such cases should express the observer's estimation, not of what was found in this or that area in the gland, but rather of the total secretory power and amount of absorbable material in the gland.

While our cases are too few from which to draw positive conclusions, yet so far as they go they seem to warrant us in making the following tentative statements from the clinical standpoint:

1. Very early acute cases show pathologically hyperemia and cellular hyperplasia, if not throughout the gland, at least in much of it, provided, of course, the more enlarged lobe has been removed.

2. Later acute, moderate, severe, and very severe cases show greater parenchyma increase, and in many instances evidence of increased absorbable secretion. Speaking broadly, the parenchyma increase is in direct proportion to the intensity of the symptoms. The relatively few variations from this rule may be accounted for by the varying resisting power of different individuals. When relatively small amounts of absorbable secretion are found in

alveoli whose walls are crowded with actively functioning cells, we may fairly assume that the secretion has already been absorbed.

3. Cases which clinically are showing any remission of toxic symptoms, show somewhere within the gland more or less evidence of decreased function in the exfoliation or marked flattening of parenchyma cells, or of probably decreased absorption, by the presence of thick, gelatinous, stainable secretion, the so-called "colloid."

4. Patients who have recovered from their toxic symptoms and are now suffering principally from long, previously acquired heart or nerve lesions, or from myxedema, although no myxedema cases are included in our present list, show exfoliated or much flattened (probably non-secreting) epithelium and large quantities of well-stained, thick, gelatinous, probably non-absorbable, colloid. In this class of cases it seems as futile to search for previous causative parenchyma increase as to look for diphtheria membrane in the throat of a patient suffering from post-diphtheritic paralysis.

5. The recently developed, very mild, or moderately mild cases of long standing show pathologically almost always some total parenchyma increase by the multiplication of alveoli, but apparently not greatly increased functioning power of the individual parenchyma cells. Goiters of the adenoid type (Groups E, F, and H) apparently pass through the same changes of hypertrophy and degeneration as those of the papilliferous type (Groups A, B, C, and D).

6. Simple goiters should be regarded as multiple retention cysts filled with non-absorbable secretion, cell detritus, etc.

THE PATHOLOGIC RELATIONSHIPS OF EXOPHTHALMIC AND SIMPLE GOITER *

By LOUIS B. WILSON

In a previous communication† I have attempted to show that certain pathologic changes in the thyroid gland have a definite relationship to the varying symptoms in Graves' disease. That such a definite relationship does exist there can be no doubt in the mind of any one who has examined any considerable number of cases, comparing the lesions with the symptoms. Such an examination invariably shows that all early acute cases of Graves' disease, of whatsoever degree of severity, show unmistakable evidence of increased secretion by the gland and of increased absorption from it. It matters not in what form the increase of functioning parenchyma occurs, so long as there is such an increase associated with unblocked lymphatics the train of symptoms best designated hyperthyroidism is present. More than this, the relative amount of increase of working tissue and absorbable secretion is almost invariably markedly paralleled by the degree of severity of the symptoms. Later in the history of any case of exophthalmic goiter, when for any reason the parenchyma cells are decreased in function, either from overwork, pressure, or insufficient blood-supply, or when lymphatic drainage is blocked either from increased connective tissue, the result of reaction to endogenous irritants, or from medical or surgical interference, it will be found that the symptoms of thyroid toxemia begin to remit.

* Read before the Pittsburg Academy of Medicine, Feb. 9, 1909. (Reprinted from "Surgery, Gynecology, and Obstetrics," June, 1909, pages 588-602.)

† Wilson: Transactions Association American Physicians, 1908, xxiii, pp. 562-578. "American Journal Medical Sciences." Dec., 1908.

Finally, when glands removed in cases of previous hyperthyroidism are found to consist of acini lined with flattened or desquamating epithelium and filled with a thick, gelatinous, non-absorbable colloid, a careful study of the symptoms of the case will show that the patient is suffering from lesions of vital organs—heart, central nervous system, etc.—which were produced by a long-passed thyroid toxemia. It has been the not unusual finding of such lesions at the autopsy table in cases dead after a long history of Graves' disease, which has served greatly to mystify our conception of the essential morbid histology. It is only by a study of such cases, sufficiently large to give a broad picture of the pathology, that one is able to trace its development.

In considering the relationships of the pathology of exophthalmic and simple goiter, we are apt to be blinded by our old teachings that the two are always distinct entities. Though this has been disproved clinically over and over again, we find every once in a while some one writing learnedly of either the diagnosis or the pathology of the two diseases, as though they never in the same individual changed from one to the other.

As a matter of fact, close inquiry will, in a very large percentage of cases of simple goiter, reveal symptoms which are unmistakably those of exophthalmic goiter, and conversely, *if the patient lives long enough*, every case of exophthalmic goiter is hypothetically destined, in the order of pathologic degeneration, to become a case of simple goiter. In examining cases of so-called simple goiter for exophthalmic symptoms, we must get completely away from our old teachings that exophthalmos is a *sine qua non* of Graves' disease. The disturbed nervous, metabolic, and muscular phenomena are quite essentially diagnostic. Looked at from the clinical standpoint, then, a case of Graves' disease is one with an enlarged thyroid, and exhibiting symptoms of too much absorbed thyroid secretion, while a case of simple goiter is one with an enlarged thyroid, but exhibiting no such symptoms.

The examination of about six hundred thyroids removed at operation by Dr. C. H. Mayo from cases of so-called simple goiter, has shown us that they are all alike in one respect: viz., that they

consist of swollen acini, whose walls are either stripped of their parenchyma or lined with thin, flattened, feebly staining epithelium, and whose contents are apparently non-absorbable; in other words, that the gland is doing a decreased amount of work, and that the tissues are not absorbing the result of its previous activity.

In arriving at a conception of the actual pathologic condition in any goiter case, it is necessary to consider the gland as a whole and not any circumscribed portion of it. Failure to recognize this rule has led in the past to the numerous loose and unsatisfactory classifications with which literature is burdened. We must remember that the absorption of a certain amount of thyroid secretion is necessary to the maintenance of metabolic equilibrium. Halsted* has shown that the excision of a portion of the thyroid in dogs results in a compensatory hypertrophy of the remainder of the gland. Similarly, when nature cuts off the absorption of secretion from a portion of the gland, there not infrequently results a compensatory hypertrophy of some other portion. Usually this compensation is accomplished by the multiplication of new acini resulting in the histologic picture of adenoma. Occasionally, though rarely, the parenchyma of existing acini may proliferate by reduplication of its layers, infolding of the acinal walls, or papillary projections into the acini. When this process is merely sufficient for compensation, no symptoms of exophthalmic goiter arise; but in simple goiter, where the proliferation proceeds to overcompensation, *i. e.*, where the increased working tissue is discharging a relatively increased amount of secretion into the lymphatics, we have symptoms of Graves' disease supervening on those of simple goiter. The condition of compensatory hypertrophy is apparently that which Kocher† designates *hypertrophic follicular goiter*, *struma parenchymatosa*, and *struma adenomatosa recurrens*, though our observations do not bear out his statement that the former is really nothing but a primary stage of diffused colloid goiter. It is true that it is occasionally seen in early cases of simple goiter, but it is also true that it, like adenomatous proliferation,

* Halsted: Johns Hopkins Hospital Reports, 1896, i, p. 373.

† Kocher, A.: Keen's Surgery, 1909, iii, pp. 336-398.



Fig. 180.

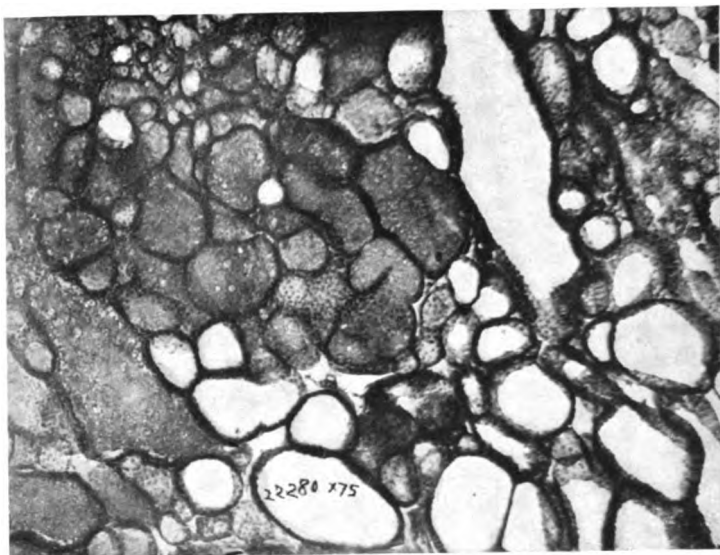


Fig. 188.



Fig. 187.



Fig. 192.

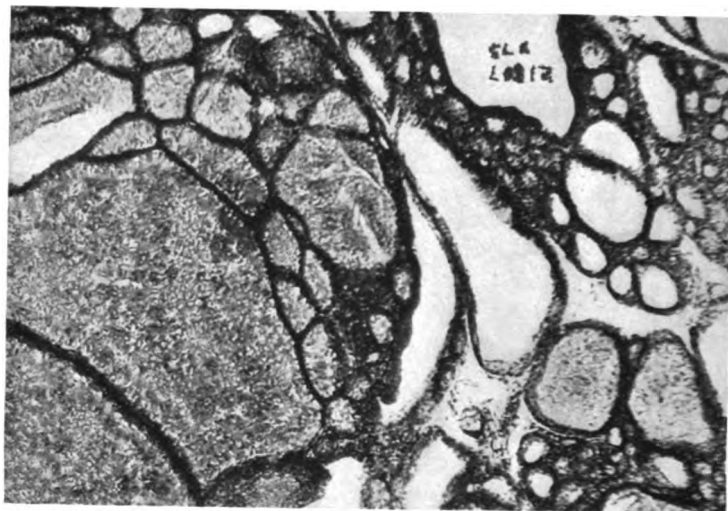


Fig. 191.



Fig. 190.

is much more frequently found in advanced cases of simple goiter in which the bulk of the gland is so blocked that insufficient secretion is being given up to the organism to maintain normal metabolism.

From the pathologic standpoint we would prefer to recognize only two principal types of simple goiter: viz., the diffuse or parenchymatous and the nodular or encapsulated; regarding focal parenchyma increase as a compensatory incident in the history of either type. It would seem probably correct also to so regard hypervascularization. Areas of hemorrhage, fibrous changes, and lime salt deposits must, of course, be considered as degenerative changes. Either type may become cystic or cancerous.

In order to make more clear the relationships of the different types of thyroid enlargement, I wish to present for your consideration portraits, photomicrographs, and brief protocols of several cases; first, a few of Graves' disease.

CASE 24550.—(Group I. Fig. 142). This specimen is a gland which is hard and nodular, the cut surface is particularly dry and granular throughout. There is considerable increased vascularity, the veins being swollen and thin-walled. Microscopically (Fig. 143) the stroma bands are thickened and extensively infiltrated with leukocytes. The alveoli are from 0.06 to 0.2 mm. in diameter. There are very few papillary projections into the alveoli. The parenchyma walls are increased in number in certain alveoli, both in the single layers and by reduplication of the layers. The cells are columnar, about 10 microns in diameter, have swollen nuclei, granular cytoplasm, and show in many areas mitotic figures. There is apparently no exfoliation of the parenchyma cells; the secretion is small in amount, thin and readily absorbable. The clinical history shows a female (Fig. 144), twenty years of age, who has had a slight symptomless enlargement of the thyroid for one year and moderate Graves' symptoms for the last two months, *i. e.*, tachycardia, fine tremor, sweating, etc.

This case represents about the earliest type of Graves' disease operated upon. Had the case been operated on before the development of Graves' symptoms, it might have been mistaken for a case of simple goiter with parenchymatous hypertrophy; such as is



Fig. 103.

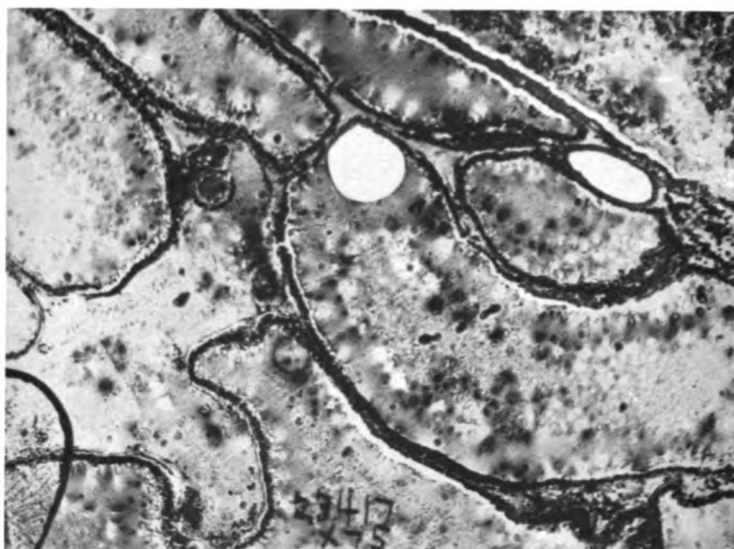


Fig. 104.

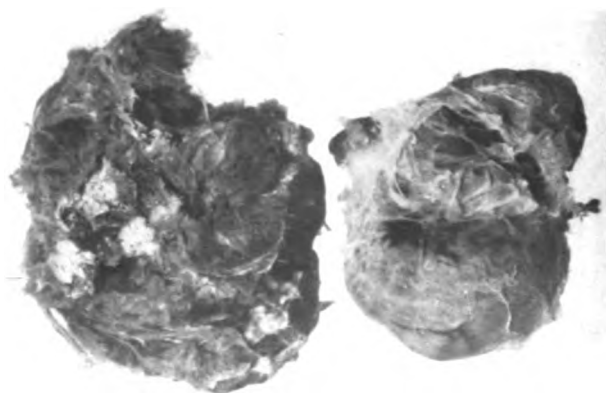


Fig. 105.

shown in the histologic picture, and with no blocking of the lymphatics. It would seem more reasonable, however, in view of the history of the case, to regard it as one in which the parenchymatous hypertrophy and overwork of the gland were being compensated for some months before the absorption became so great as to render compensation no longer possible, with the consequent development of Graves' symptoms. It does not seem that such cases should be considered as simple diffuse goiter.

CASE 23448.—(Group II. Fig. 145). Shows you a photograph of a gland of the same character grossly as the preceding. Histologically, however (Fig. 146), there is a large amount of intra-alveolar parenchyma, increased papillæ formation, and a large amount of thin secretion. Clinically (Fig. 147), the patient is a woman, twenty-eight years of age, with a history of two years of Graves' disease, and at present severe symptoms: viz., tachycardia, nervousness, tremor, profuse sweating, some diarrhea and vomiting, and exophthalmos.

CASE 23099.—(Group III. Fig. 157.) This is a 120-gram gland, hard, nodular, with a granular, glairy cut surface, and swollen tortuous veins. Histologically (Fig. 158), there are large alveoli with great intra-alveolar parenchyma increase, increased papillæ formation, and a large amount of thin, non-staining secretion. As can be seen in both the 75- and the 150-diameter magnifications there is beginning cytolysis. Clinically (Fig. 159), the patient is a female, thirty-six years of age, who has had progressive symptoms of Graves' disease for three years. The symptoms are now of very severe type, *i. e.*, tremor, palpitation, tachycardia, diarrhea and vomiting, with pronounced exophthalmos for one and one-half years.

These two cases illustrate very well the usual pathologic findings in the severe non-remittent types of Graves' disease. They represent much the largest group of our cases. The incident of marked cytolysis in cases of this kind is invariably associated with symptoms of unusually severe type, it having been found present in all our cases that have died, either with or without operation, with severe symptoms of thyrotoxicosis.

CASE 22473.—(Group IV. Fig. 163.) This is a 35-gram gland,

whose granular, glairy cut surface presents some alternating areas of gelatinous appearance. Histologically (Fig. 164), the large alveoli contain numerous papillary projections, but the columnar parenchyma cells are exfoliated in many areas. There is a large amount of secretion, much of which is thin and non-staining, but some of which is thickened and stainable. Clinically (Fig. 165), the patient is a woman, twenty-nine years of age, who for three years has shown symptoms of Graves' disease which, although now of severe type, are nevertheless less severe than they have been previously.

This case represents our third group of exophthalmic goiter. They are those cases which pathologically show an early degeneration of the parenchyma, and, clinically, more or less remission of symptoms.

CASE 21374.—(Group V. Fig. 169.) This is a 200-gram gland, hard and nodular externally, with a gelatinous cut surface. There is no markedly increased vascularity, while the stroma has materially increased. Histologically (Fig. 170), the alveoli are quite large (0.6 to 1 mm.). There is almost complete exfoliation of the parenchyma cells, but the original character of the gland is distinctly shown by well-preserved remains of papillæ in some of the alveoli, as will be seen in the 75-diameter magnification.

This case is a woman (Fig. 171), one of the fourth group of our series, which pathologically show marked degeneration and a previously greatly increased functioning parenchyma, and clinically show marked total improvement, though some of the cases may still be suffering from symptoms due to the lesions, long precedingly acquired, of the vital organs.

CASE 21964.—(Group VI. Fig. 175.) This is an 88-gram gland, hard and nodular externally, and showing small cysts on its cut surface, which is otherwise dry and rather solid looking. Histologically (Fig. 176), the alveoli are found to be small, many of them of the fetal type. They are very numerous and proliferating. There is only a small amount of a thin, non-stainable secretion. Clinically (Fig. 177), the patient is a female, thirty-three years of age, who has had a slowly developing gland for six

years with Graves' symptoms coming on so slowly that they caused no disturbance until two years ago, and even now they are moderately severe.

This case represents our fifth group. In the present instance there seems little doubt that the case is one of a proliferating adenoma from the beginning, since throughout the gland there is no evidence of accumulation of markedly thickened colloid, and since the symptoms, though mild at all times, nevertheless presented a continuous development.

Exophthalmic goiters of this adenomatous type present the same stages of proliferation and degeneration as do those of the intra-alveolar series. It is sometimes extremely difficult to distinguish these cases pathologically from cases in which the symptoms of hyperthyroidism have developed after a long history of simple goiter. However, speaking broadly, it may be said that where exophthalmic symptoms have supervened on old colloid goiters the tissue is apt to show relatively small areas of relatively highly active parenchyma, while in cases of long-standing, mild, continuous symptoms of exophthalmic goiter associated with the adenomatous type of gland, the gland throughout shows its adenomatous character with all of its parenchyma relatively more degenerated than in the previous cases.

Let us turn now to the so-called simple goiters, taking up first those of the diffuse type:

CASE 22280.—(Group VII. Fig. 187.) This specimen represents one entire lobe weighing 170 grams. While somewhat nodular over its surface, one can plainly see that the entire lobe is involved. The vessels are swollen and tortuous, the goiter being of the highly vascular type. The section (Fig. 188) shows enlarged acini with thin parenchyma lining their walls. Many of the acini are filled with stained granular secretion; a few are empty, indicating that the secretion in these places was thinner and washed out during the process of preparation of the tissue. It will be noted also that the epithelium lining the empty acini is not so thin as that lining the filled acini. The patient is forty-three years of age, with a bilaterally symmetric goiter (Fig. 189). The goiter

began to develop sixteen years ago and has gradually increased to its present size. It was entirely symptomless until six months ago, when some difficulty in breathing was first experienced. During the last two months there has been general nervousness and some palpitation of the heart.

Here is a case of an old, simple goiter which has recently grown enough, or has recently opened up its lymphatic channels sufficiently, to permit absorption, and thus produced mild symptoms of exophthalmos.

CASE 21807.—(Group VIII. Fig. 190.) This specimen weighed 544 grams and consisted of one lobe and the isthmus. It is seen to be a diffusely enlarged thyroid with swollen tortuous vessels over its surface. The freshly cut surface is homogeneous and shows thick, gelatinous colloid. Histologically (Fig. 191), we find small to very much enlarged acini lined with flattened epithelium and filled, for the most part, with thick, stainable secretion. The patient (Fig. 192), is a woman, fifty years of age, who has had a goiter on the left side for twenty years, on the right side for fifteen years, and a central connecting tumor for two years. There have been no symptoms at any time, except recently dyspnea.

This case illustrates very well the ordinary diffuse colloid goiter, which may involve one or both lobes, and which is symptomless.

CASE 23417.—(Group IX. Fig. 193.) The specimen from this case consists of one lobe, weighing 120 grams, which was removed in two portions. It is nodular and not highly vascular. The freshly cut surface shows dense, gelatinous colloid throughout the bulk of the gland, but beginning calcareous degeneration near the center. Histologically (Fig. 194), the thick, stainable type of colloid is seen in the undegenerated areas. Clinically (Fig. 195), the patient is a woman, fifty-seven years of age, whose goiter began developing thirty-three years ago, during her second pregnancy. She has no symptoms, except some difficulty in swallowing and breathing. The facial appearance suggests early myxedema and her history shows that she has gotten much "fuller in the face" in the last two years.

CASE 22693.—(Group X. Fig. 196.) The specimen in this case consists of one lobe and the isthmus, weighing 178 grams;

the surface and sectional views showing the goiter to be quite vascular in some areas and quite avascular in others, with areas of dense fibrous tissue and some lime deposits. The microscopic section (Fig. 197, B), from a soft vascular area, shows very much enlarged, irregular acini with thin walls,—from which the epithelium has desquamated,—and filled with thick, stainable colloid. A section from one of the fibrous areas (Fig. 197, A) shows the fibrous change to have taken place not only between the acini, but also within them. This patient is a woman (Fig. 198), thirty-three years of age, who has had her goiter but eight years. Her only symptoms have been those of headache, slight dyspnea, and pain on the neck during the last few months. It is rather unusual to find such advanced degenerative changes in a woman so young and with a goiter so recent.

CASE 22567.—(Group XI. Fig. 199.) This specimen is a single lobe, smooth, non-vascular, weighing 410 grams, and showing on fresh section almost complete fibrous and calcareous change. The microscopic picture (Fig. 200) from the edge of the tumor at first sight would be pronounced cancer. This appearance, however, may be due to the pressure of the fibrous capsule on the unyielding interior of the gland. The patient (Fig. 201) is a woman, fifty years of age, whose goiter began with her first pregnancy twenty-six years ago, and continued to enlarge during her three succeeding pregnancies for the next twelve years, since which time there has been no change. Her only symptoms were a slight difficulty in respiration. One and one-half years after her operation she is reported in good health.

These last three cases illustrate very well the principal secondary changes, aside from cysts and malignant growths, which occur in old, simple, diffuse goiters.

CASE 23267.—(Group XII. Fig. 202.) This specimen represents an encapsulated tumor filling almost the entire right lobe and weighing 151 grams. Histologically (Fig. 203), we find it to be pure fetal adenoma, some portions showing very recent development and others more advanced. Clinically (Fig. 204), the patient is a woman, twenty-nine years of age, who has had a gradual enlargement of the right lobe of the thyroid for the last six years.

CASE 23277.—(Group XIII. Fig. 205.) This specimen is a spheric, encapsulated tumor removed from the right lobe of the

thyroid and weighing 76 grams. Fresh section shows a smooth, solid structure. The sections (Fig. 206) from some areas show a fetal adenoma type, similar to that of the preceding case, with gradual changing into the ordinary adenomatous tissue, which in other areas is seen to be advanced, with acini swollen and filled with stainable colloid. The patient (Fig. 207) is a woman, forty-one years of age, who has had a gradual enlargement of the thyroid since her nineteenth year. She has had some dyspnea at all times with occasional nervous attacks during the past ten years.

These two cases illustrate the single nodular encapsulated, tumor type of goiter, which usually begins as a fetal adenoma, and whose acini gradually fill up first with thin and later with thick gelatinous colloid.

CASE 23237.—(Group XIV. Fig. 208.) This specimen represents four nodules with a total weight of 80 grams, which were shelled out from the left lobe of the thyroid. The microscopic section (Fig. 209) shows a fetal adenoma with the acini in various stages of development, and the edge of a cyst whose epithelium is much flattened and degenerate. The patient (Fig. 210) is a man, forty-one years of age, who has had his goiter for two and one-half years. During the last month he has presented some nervous symptoms.

This case is one of multiple adenoma, and is typical of early cyst formation, which is very frequently present in either type of goiter. It also illustrates that clinically we may have symptoms of exophthalmos arising from the fetal adenomata as well as from the diffuse goiters.



Fig. 108.



Fig. 107 B.



Fig. 106.

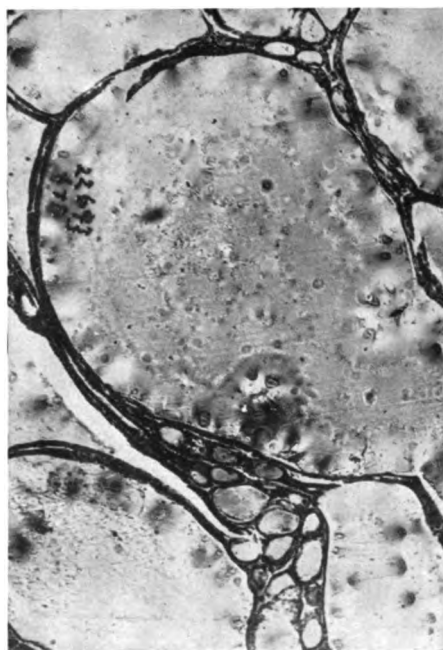


Fig. 107 A.



Fig. 201.

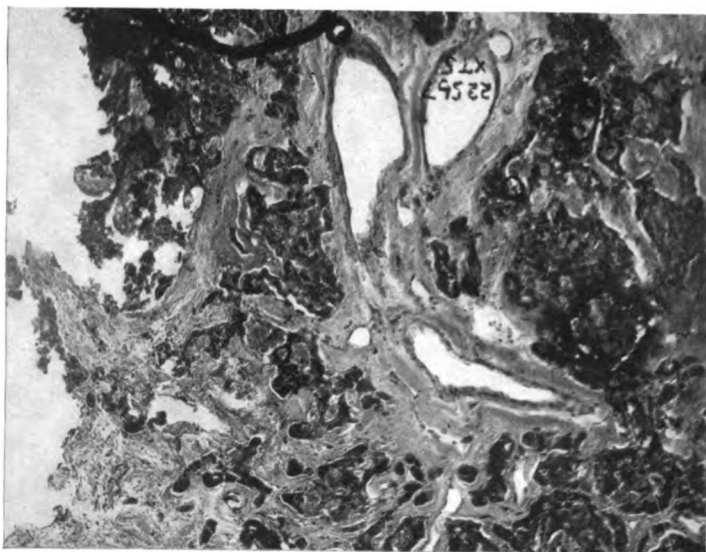


Fig. 200.

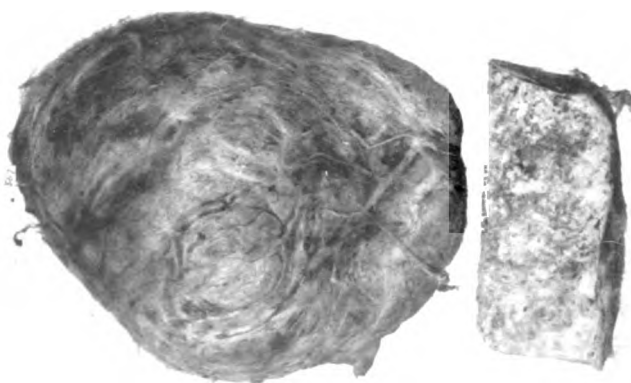


Fig. 199.

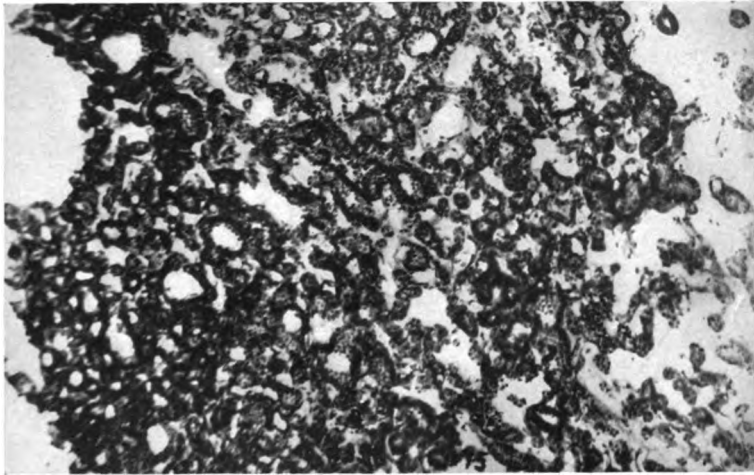


Fig. 203.

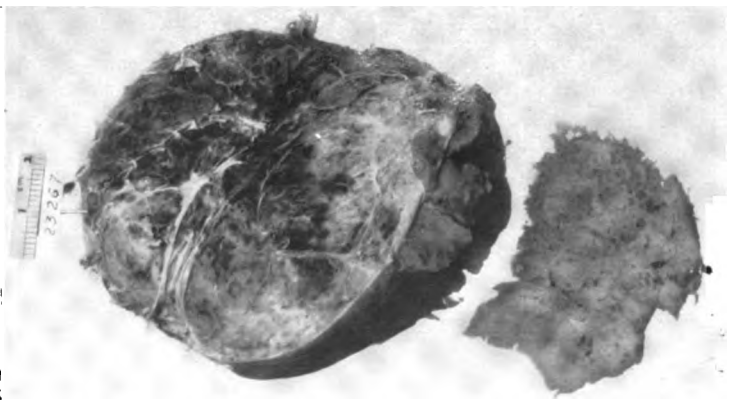


Fig. 202.



Fig. 204.

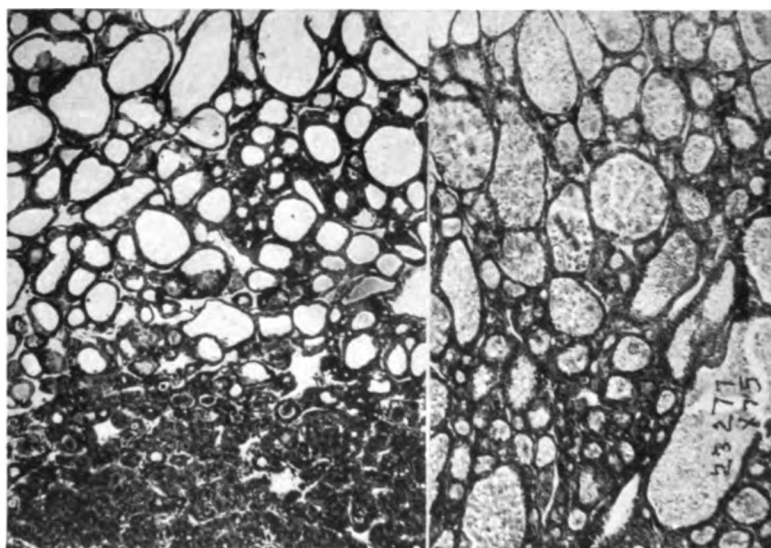


Fig. 206.



Fig. 207.

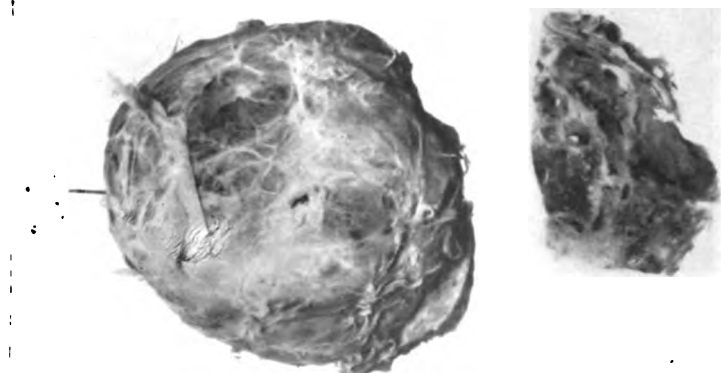


Fig. 205.

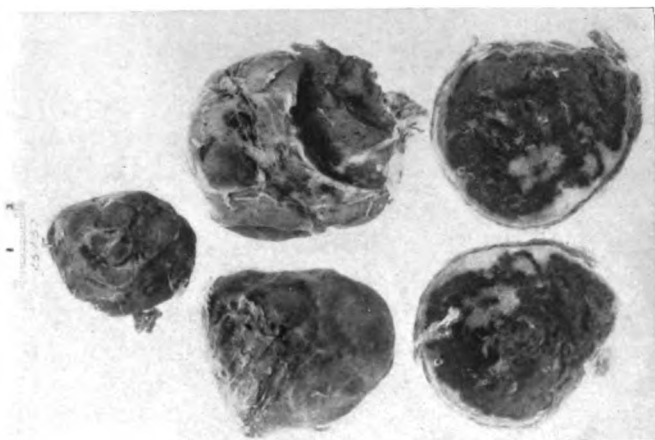


Fig. 210.

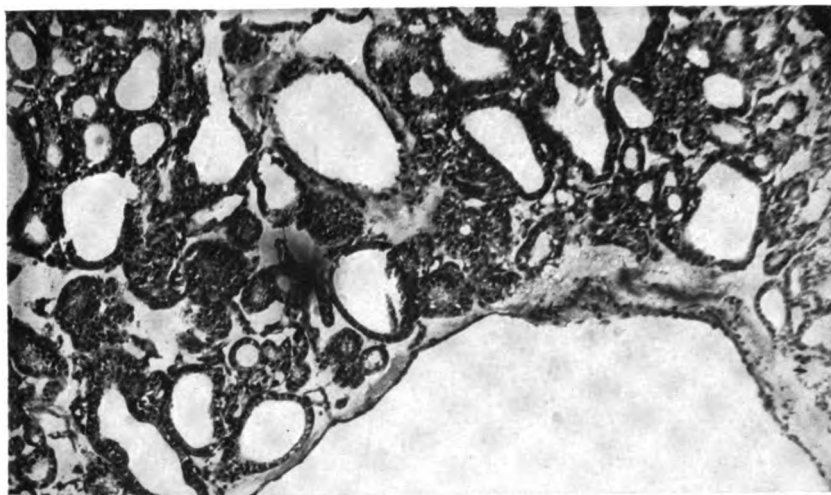


Fig. 209.



Fig. 208.

MORTALITY AND LATE RESULTS FROM THYROIDECTOMY IN EXOPHTHALMIC GOITER OR HYPERTHYROIDISM *

By CHARLES H. MAYO

Many diseases have been named from some prominent feature or symptom, the specific germ of which has only been found within comparatively recent times. From our knowledge gained in laboratory findings, diseases of the various organs which have heretofore been merely described are finally placed upon a sure basis of cause and effect.

Hyperthyroidism, or exophthalmic goiter, has been held in a fog of superstition and dogmatic statement for a long period of time, its treatment as dependent upon chance as upon symptomatic indications, with no basis of facts in the laboratory findings until quite recently. Cures have occurred without treatment as well as with almost every possible type of treatment, accident, or disease.

In hyperthyroidism we have a certain definite condition, which shows in the gland so regularly that an experienced pathologist, from an examination of the gland alone, can give the symptoms and general condition of the patient from whom the gland was removed in 80 per cent. of cases.

Exophthalmic goiter is an especially bad term to employ, as a considerable percentage of cases may lack one or both of these conditions during a period of the disease. Hyperthyroidism is recommended as being a far more natural and descriptive term than Graves' disease, Basedow's disease, or exophthalmic goiter, for general use in describing the condition.

In our hospital work we find that the number of patients suffer-

* Reprinted from "The Transactions of the American Surgical Association," 1908.

ing from hyperthyroidism is greater in proportion to those with ordinary goiter than formerly. They are sent from a greater area of country, and do not represent a normal ratio in any particular locality. We have over 300 such cases in 750 operations for goiter.

In the more serious cases thyroidectomy is now often preceded by a preliminary ligation of the superior thyroids, but this plan has not been followed with regularity for a sufficient period of time so that these cases can be considered in this report.

Many patients will not recover good health, since the disease has been the cause of various terminal degenerations before operation was performed. A few suffer from hypothyroidism, or myxedema, with the result of destruction or loss of secreting epithelium. Operation will only relieve pressure symptoms.

While we have some remarkable cures of patients operated upon as long ago as fourteen years, the greater number of our operations have been made within the last four years, and the results in these cases have confirmed our belief in the efficacy of surgical procedures.

In the earlier results we had 50 per cent. cured within a few weeks, 25 per cent. cured within a few months, 25 per cent. improved but suffering from relapses of former symptoms. Some of these should have been operated upon for the removal of more gland, which we have done successfully several times.

The mortality from the early thyroidectomies represents more than should be properly surgical, because of the advanced condition of the trouble when the patients were referred to the surgeon. In over 300 operations our mortality has been: 4 deaths in the first 16 cases, 3 in the next 30, 1 in 75, 2 in 75, and 4 in the last 134.

During the years 1905-06-07 we performed 200 operations for hyperthyroidism. Of this number, 22 were males and 178 females. Ten, or 5 per cent., of these cases died as a result of the operation. Letters were sent to the remaining 190, and answers received from 167.

Of these 116, or 70 per cent., were cured; 32, or 19 per cent., improved; 10, or 5.8 per cent., slightly improved; 9, or 5.2 per cent., not improved.

A CONSIDERATION OF THE MORTALITY IN ONE THOUSAND OPERATIONS FOR GOITER*

By CHARLES H. MAYO

In conquering serious diseases by surgical measures it is important that the operation itself should be as free from mortality as possible. This is especially true when it concerns diseases that have a low mortality, no amount of deformity or discomfort being weighed against possible death from operation. Once surgical technic and judgment render the operation comparatively safe, former serious procedures are chosen as operations of expediency; thus we are able to group together the mild and the serious, and the operative mortality becomes still lower, and more attention is devoted to reducing disability and increasing the permanency of cure.

In a country of such enormous territory as ours, over which goiter is quite generally though not extensively distributed among all classes of people, it is still considered a rare disease and of a serious nature only when operated upon. The advice of the old family physician is still respected by many patients, to the effect that if they were operated death would probably result, or should they recover they would run the risk of developing some hideous skin disease, "myxedema," or that they might become "foolish," the latter warning usually being quite effectual in helping them determine as to their procedure.

It is true that in the early surgery of goiter in this country the mortality was high for the number of cases operated upon, as usually the operations were of great urgency or necessity, especially in the cases of so-called "exophthalmic goiter" (hyperthyroidism),

* Read before the Southern Surgical and Gynecological Society, December, 1908. (Reprinted from "Surgery, Gynecology, and Obstetrics," March, 1909, pages 237-240.)

and only the very worst types were sent to the surgeon, these often in a nearly moribund condition after the delay of a long-continued and oft-changed medication. To mention these conditions is merely to indicate what can be said of diseases of the stomach, liver, prostate, etc., a brief detail of increasing knowledge in the development of surgery.

Operations upon colloid, simple or diffuse adenomata, and upon encapsulated adenomata, as a rule, involve but slight risk to the life of the individual. Many patients who are so afflicted wish to be relieved of the deformity, tracheal pressure, and hoarseness, or possibly a severe neuralgia. But from the examination of a large number of varied tumors of this nature, we must say that, despite the enormous discomfort and suffering with which the disease may be accompanied, actual death occurs but rarely, and then only from intrathoracic or from malignant or degenerative change in the gland. We have had a number of large goiters exceeding 20 inches across the front of the neck and tumor from one side to the other. One tumor measured 31 inches in circumference, including 4 inches of the back, the only free portion of the neck.

In our series of cases there were, in all, five hundred and seventy-four cases of simple, colloid, or diffuse adenomata, including encapsulated goiter, adenoma, and cystadenoma, including also four operations for accessory thyroids in the lines of development, one being a lingual thyroid. All were treated by extirpation or enucleation. Two operations were incisions and drainage of acute inflammatory conditions. There were four deaths in this series, one being from lobar pneumonia on the eighth day, another from two severe delayed hemorrhages, one from shock in which we found brown atrophy of the heart, fatty infiltration of the liver with gall-stones, and one from septic pneumonia on the fourth day.

In another large class of cases we use the term "hyperthyroidism" because we believe it will come into general use in describing a condition which manifests such varied symptoms, and it is probable that then earlier relief will be given to many who are now treated for heart disease, nervous disease, gastric crisis, and intestinal toxemia until a projecting eyeball or goiter becomes sufficiently

prominent to attach the label of Parry's disease, Graves' disease, Basedow's disease, or exophthalmic goiter to the unfortunate individual, who must then run the gauntlet of the enormous variety of therapeutic agents which are good for the disease when properly christened.

It is quite probable that many cases of hyperthyroidism never progress beyond the early stages and are not diagnosed as such, and it is probably true that many cases in advanced stages of the disease get well with, without, or in spite of, treatment. We believe that one-fourth the number do so. Yet in hyperthyroidism, Ewing's, MacCallum's, and especially Wilson's report of 294 cases* show a definite change in the structure of the glands in this type of disease, and the results from the reduction of secretion are certainly almost marvelous.

In our early surgical work in hyperthyroidism, beginning some fifteen years ago, only the most desperate cases were thus treated, and we considered results up to the average which gave 25 per cent. mortality in the first sixteen cases. One of our fatalities occurred on the table. Better judgment in selecting a favorable moment for operation, with more careful preliminary preparation of the patient, and there were but three deaths in the next forty operations for the disease. In this connection I might say that during the last two years six cases coming to us from a distance died a medical death between the fourth and ninth day after reaching the city, their inoperable condition being recognized because of former experience. Fortunately, we were able to compare the autopsy reports of these cases with conditions which were observed in deaths following surgical procedures upon the gland. In all of those who died the reports were to the effect that there was degeneration of the heart muscle, fatty liver, softspleen, and chronic nephritis, and usually enlarged thymus. One very marked case dying without operation the fifth day under observation had no palpable thyroid gland, yet the autopsy showed it to be enlarged and weighing over 3 ounces.

The various degenerative changes in the gland, with increased

* "American Journal of Medical Sciences," Dec., 1908.

cell activity, have explained why, in advanced and delayed cases with what might almost be called "terminal degenerative conditions," the mortality is not only increased, but also why a satisfactory cure does not follow in many instances where great operative skill has avoided mortality. Such cases should be compared to the removal of a bullet from the body with the expectation of obtaining relief from all injury caused by its passage.

There were four hundred and five cases of marked hyperthyroidism operated upon, with nineteen deaths. Most of these (three-fourths) were treated by extirpation of one lobe, usually the larger right and the isthmus, and sometimes a part of the left being removed. Occasionally an adenomatous condition could be enucleated. In the early stages of the disease very mild cases were treated by ligating arteries and veins at both upper poles, which represent about one-fifth of the ligated cases. Nearly all of the others operated upon in this manner were the worst possible type of cases which could be chosen, and the operation was done only as a preliminary treatment in preparation for the removal of a portion of the gland later. In the most aggravated cases, where there is dilated heart, adenoma, and ascites, preliminary preparations were frequently prolonged for several weeks before the operation could be undertaken. These patients improved quickly under the various forms of treatment, such as medication, x-ray, rest, etc., but they may also fail rapidly.

In operating we are careful to avoid periods of gastric crisis or intestinal relaxation, and the operation may be postponed several times, waiting for a favorable opportunity. Some form of operation may be considered beneficial which has for its object the reduction of secretion, either by lessening the circulation, by ligation of the vessels, or by removal of a portion of the gland.

There were ninety-seven cases of hyperthyroidism treated by double ligation of the superior thyroid arteries and veins with one death, and fourteen cases of ligation of the superior thyroid and veins of the remaining lobe after extirpation of one lobe and isthmus were found to have improved the patient, though not to a satisfactory extent. There were two hundred and ninety-five cases of

removal of more or less of the gland, with eighteen deaths, seven of which occurred in the first forty-six operations. One of these deaths occurred on the table from shock, fifteen from hyperthyroidism, nearly all within twenty hours after operation, two from embolism, one pulmonary and one cerebral.

After all has been said concerning the various dangers from operating for ordinary adenomatous goiter, we consider hemorrhage, either primary or delayed, with the efforts made to control this usually accidental condition, as the primary cause of death. Delayed hemorrhage occurs usually from including some muscle-fiber in the ligation of the superior thyroid artery. Fortunately patients operated upon for the various forms of adenomatous goiter are almost always able to withstand serious hemorrhages. The occurrence is far more serious in the extreme cases of exophthalmic goiter with degenerated and dilated heart and other complications associated with such conditions, although hyperthyroidism, with a continuance and increase of all symptoms, is usually the cause of death in this latter form of the disease.

As to the dangers from injury or removal of the parathyroids, we believe that with ordinary precautions, and with the modern operation, such a result may be expected about as often as pulmonary embolism may be looked for in abdominal surgery. The danger of such injury will seldom occur in operating for exophthalmic goiter, but care must be exercised in preserving the posterior capsule in the operation upon colloid goiter in which both lateral lobes of the thyroid are attacked at the same or separate periods.

Cancer and sarcoma of the thyroid are most serious conditions. In the early stages of both a cure may be possible, but it will usually be in the unsuspected case. Cancer of the thyroid which has progressed so far as to be readily diagnosed, is practically incurable. Inasmuch as goiters of long standing may become malignant, and as in such cases the change is usually accompanied by rapid, irregular growth of a long stationary gland, as a rule with loss of weight and other symptoms of irregular hyperthyroidism, it is proper to state to individuals thus affected that an operation should not be long postponed.

In the series there were eighteen cases of cancer with one death, which was occasioned by tracheal collapse from softening of the rings, and two cases of sarcoma with no mortality. There were fully half as many patients with malignant thyroids who appeared too late to derive any possible benefit from a surgical operation, and it was not, therefore, advised.

In the after-care of patients all but the simplest cases receive a quart of saline rectal enemata given very slowly immediately after the operation. This is repeated in a few hours, and in extreme cases again ten hours after operation. Should there be intestinal relaxation, as in extreme cases of Graves' disease, subcutaneous use of the saline is substituted for the rectal method. Morphin is employed for extreme restlessness. Cold over the pericardial region in marked palpitation seems to be of benefit, and if exhausting perspiration is a symptom, it is controlled with repeated small doses of atropin.

The anesthetic given had been ether, preceded by atropin, $\frac{1}{120}$ gr., and morphin, $\frac{1}{6}$ gr. Only twenty odd operations were made under cocain anesthesia.

THE PARATHYROID QUESTION *

By CHARLES H. MAYO

For more than fifty years reference has been made by various authors to peculiar gland bodies that were quite regularly associated or connected with the thyroid glands.

Sandström's¹ excellent description of what he called "accessory thyroids" was given in 1880, and Gley² demonstrated later that tetany was caused by the removal of these glands in thyroidectomy. Rogowitz,³ Christiani,⁴ Zielenska,⁵ and Hürthle,⁶ respectively, described as embryonic thyroids similar bodies in various animals.

In 1895 Kohn⁷ made note of four epithelial capsules to the individual, although more or fewer have been noted occasionally.

In 1898 Welsh⁸ gave us an exhaustive description of the parathyroids, which he designated as posterior superior and anterior inferior.

Moussu,⁹ Vassale and Generali,¹⁰ and Jeandelize¹¹ believed that a deficiency of parathyroid secretion occurred in exophthalmic goiter, and they, with others, thought the same condition was the probable cause of various forms of convulsions.

Lundberg¹² believed that paralysis agitans was also caused by a deficiency of secretion, his theory being shown by Thompson¹³ as erroneous in an examination of nine cases at autopsy. Thompson's statement is supported by other investigators.

As stated by the more careful observers, the parathyroid glands are four in number, usually without the true capsule of the thyroid gland. They are 6 or 7 mm. long, 3 to 4 mm. wide, and 2.5 mm. thick. They are supplied by a terminal artery entering the hilus. The arterial supply is mostly derived from the inferior thyroid

* Read before the American Surgical Association, June 4, 1909. (Reprinted from "Annals of Surgery," July, 1909.)

artery, or from the anastomotic branch between the superior and inferior thyroid arteries. The parathyroid glands are often designated as *superior* or *external*, and *inferior* or *internal*.

There are wide variations in the effect of the removal of the parathyroids in various animals, especially the herbivorous animals, in whom the bodies may be irregularly placed at a distance from or within the thyroid, making it difficult to be positive as to their complete removal. Extirpation of the parathyroids of animals, especially in dogs, is quite regularly followed by tetany.

The association of function of the glands like the thyroid, parathyroid, thymus, suprarenal, and others becomes more marked as continued investigation discloses the various changes consequent on disease or on removal of the various glands. It is probable that some of the glands act through the hormones or chemical messengers, and that others are more reflex in effect. MacCallum and Voegtlin¹⁴ especially mark the changes in calcium metabolism incident to parathyroid deficiency.

The pathologic changes are of simple types, *i. e.*, degenerations, hemorrhages, cysts, and seldom tumors. There are about a dozen tumors of the parathyroid reported, most of these being found at autopsy, and all were benign adenomata.

From such reports it would appear that these glands as compared with other organs and lesions are singularly free from serious diseases, especially those of a surgical nature. This explains why our information is gained principally from accidental findings incident to their injury during operation upon associated structures, and from direct experimental work upon animals, thereby differing from the more recent medical advances.

The greatest progress in our working knowledge of the pathology of the body in general has come from the treatment of surgical conditions, and from a consideration of pathologic changes in the living.

In the surgery of the thyroid, not considering sepsis, we have always had reason to fear hemorrhage, both primary and secondary, as well as injury to the recurrent laryngeal nerves. Must we not be watchful of the parathyroids? While the deaths from their

injury will probably be fewer than those from the first mentioned condition, the character of the death with convulsive seizures seems more shocking than from any other cause.

In twelve hundred operations for goiter we have seen no tetany, and it is possible that certain principles of operation which were developed long before there was a parathyroid question may have contributed to the preservation of the parathyroid bodies.

Freedom from hemorrhage, *i. e.*, a bloodless operation, has not been a marked feature, as the superior thyroid artery is usually the only large vessel ligated as it enters the gland. Other vessels are caught by many forceps as they pass through the capsule. The posterior capsule is carefully preserved in all operations upon the thyroid. We believe this technic best for the occasional or inexperienced operator, but possibly not necessary for the experienced surgeon who continuously maintains a dry wound. Cystic tumors or encapsulated adenomata are usually treated by the Partia-Socin-Billroth method of enucleation. Large colloid growths are treated by extirpation of the larger lobe and resection of the other side. When the enlargement is marked and nearly even, resection on both sides, as advocated by Mikulicz, is an excellent method of reduction.

Operations upon cases of hyperthyroidism are usually confined to one side, and, the blood-supply being free, there is but little danger of subsequent hypoparathyroidism.

As the removal of supposed lymph-glands or small accessory thyroids is not essential in operation for goiter, we make it a rule to implant such bodies, when accidentally removed, into the capsule of the remaining lobe or in some other acceptable location in the exposed tissue of the neck. It is quite possible that the human being with four parathyroids has some to spare, and that if those on one side are preserved, no untoward consequences will follow. This phenomenon has been noted in other double structures—the kidneys, ovaries, etc. In four instances in which one parathyroid body was removed we noted no unusual symptoms during recovery.

Should tetany follow an operation for the removal of the goiters, the indications are to administer calcium salts, preferably the lac-

tate, in 4 to 5 per cent. solution intravenously, by stomach or by rectal enemata. This has been found most efficient in dogs, by Voegtlin and MacCallum, although Beebe and Berkeley¹⁵ in a similar series of cases of experimental tetany were not so favorably impressed with the efficacy of the calcium as with the use of their parathyroid serum.

In experimental tetany bleeding seems to be of temporary benefit, but it is probable that in most human beings in which it occurs the operation will have served that purpose.

If the above remedies can but maintain life until parathyroid glands can be secured, transplanted, and function obtained, it may be possible to tide the patient over into a chronic state which may later become a cure.

In a report of cases and of experimental work Halsted¹⁶ reports having secured benefit not only from the use of serum, but from feeding both dried and fresh beeves' parathyroids. He found it necessary, in order to secure the success of the transplanting of the parathyroids, to first cause a parathyroid deficiency. While he obtains the best results by implanting the glands beneath the posterior sheath of the rectus abdominis, others have apparently succeeded by grafts into the remaining lobe of the thyroid, into the spleen, peritoneum, and other locations.

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THE OPERATIVE TREATMENT OF HYPER- THYROIDISM*

By CHARLES H. MAYO

Hyperthyroidism or overactivity of the thyroid is now considered the cause of a group of associated symptoms which have been described under many different names.

The condition was described by Parry in 1825, by Graves in 1835, and by Basedow in 1840, and for which Kocher now proposes the term *thyrotoxicosis*. The name commonly used, *exophthalmic goiter*, is not a good term, as many of the patients do not have a goiter and others do not have a prominent eye, while some of them have neither of these symptoms in the early stage of the disease when a diagnosis might be made if these symptoms were not considered of so much importance. Considering how little was known of the disease until the last few years, many authors should be given credit for the bits of knowledge gained from time to time.

It was a lack of definite or fixed pathology, permitting the appellation of many descriptions and many names, that aided the long delay in accepting the disease hyperthyroidism as a real condition and the opposite of hypothyroidism.

The essential feature of the condition is that the whole of the gland, or only a part, shows an overactivity from the cell changes. The cells are increased, there being more of them in the vesicles, or more vesicles. The overproduction of secretion in some of these cases must be enormous. The laboratory findings correspond with the symptoms in the greater number of patients operated upon.

The most active condition of hyperthyroidism does not necessarily require the presence of a large tumor or goiter, as, after the

* Reprinted from "Surgery, Gynecology, and Obstetrics," June, 1909, pages 602-605.

gland has doubled its size, the greater increase usually consists of colloid, a retention complement change occurring in the secretions retained in the vesicles.*

Such a condition has influenced older writers to state that there is no difference between the gland in Graves' disease and the glands in ordinary goiter, while, in fact, that which is retained in the gland may from its size cause trouble of various forms, because of the size of the development, but does not cause the symptoms under discussion. These are caused by a thin, non-stainable secretion, the *iodothyroglobulin*, which has been and is leaving the gland, probably by the way of the lymphatics.

Several symptoms are prominent in the disease, two of which are closely associated—tachycardia and tremor. In certain cases, during the two decades of life from forty to sixty, these without other marked symptoms must be differentiated from myocarditis.

The eye symptoms are peculiar to the condition. The eyes may protrude greatly or, because of the widening of the palpebral fissures, they may appear to protrude (Stellwag). The upper lid lags in looking down (Graefe). The lower on looking up (Kocher). The extreme protrusion may cause diplopia for near work (Möbius). The sudden recession of the lids when fixing the eyes upon a near point has been noted (Sandström).

As already mentioned, a goiter is not an essential condition to marked hyperthyroidism. In a death from unoperated acute Graves' disease in which the thyroid was apparently normal to palpation both before and after death, the autopsy showed the gland to weigh nearly three times the normal, and to be typical in the structural changes present.

Muscular relaxation is often a marked feature, the constant exhaustion resembling that of the tired athlete, or that due to heart disease of the muscular type. In extreme cases muscular twitchings like those of chorea may be noted in addition to tremor. Gastric crisis of severe variety occurs with but little warning, and vomiting lasts from one to several days. The intestinal symptoms are those of relaxation, diarrhea, or loose bowel movement, with

* Wilson: "Am. Jour. Med. Sciences," Dec., 1908.

but little increase in the total quantity, thus differing from ordinary toxic conditions.

Circulatory changes are marked in the increased frequency of the pulse and in the excess of blood in the capillary and smaller vessels. The pulse ranges from 110 to 200 or more, representing the range from mild to extreme rapidity.

The extraordinary amount or proportion of the blood in the small vessels, the heart having lost the *vis a tergo*, increases the rapidity of action upon a smaller quantity of blood. Later, when the overwork and toxemia from the elimination of the disorganized epithelium of the thyroid have caused a degeneration of heart muscle, liver, spleen, and kidney, we have a dilatation of the heart with irregularity in rhythm and tension, incomplete contraction and imperfectly closed valves, with resulting pulsating large veins, and the blood-pressure often drops to a low point. Fatty liver and kidney changes become marked, and we have albuminous urine, ascites, and edematous feet and limbs to mark this extreme condition.

Skin changes are increased feeling of warmth, sweating, with the more rapid, general metabolism manifest, and when general toxic degeneration is present the skin, as a rule, becomes pigmented.

Hyperactivity of the thyroid may begin in early childhood, the earliest we have seen beginning in one child of four and one of five; the latter was seven years of age when a thyroidectomy was made. A moderate amount of hyperthyroidism is not infrequent in girls at puberty and a few years following, a period of natural activity of the thyroid from sexual development. This is often true of the normal thyroid during pregnancy.

In some cases the goiter, and again the eye changes, will appear early, or these may be late symptoms, while in others the goiter will have existed as a simple colloid for a long time previous to overactivity.

Unilateral exophthalmic goiter is usually that variety caused by the stimulus of an encapsulated adenoma growing in the lobe of the thyroid, which later causes pressure absorption of the gland,

with attacks of intermittent hyperthyroidism, and in which all the symptoms occur except that of proptosis.

The surgical treatment of hyperthyroidism must embody methods of reducing the secretion of the gland. Operating upon other tissues in the thyroid by the Jonnesco or Jaboulay method of removal of the sympathetic ganglions is, because of our increasing knowledge of the disease, a method quite obsolete.

The reduction of the blood-supply in the gland or a removal of a varying quantity of the gland is at present the accepted method of surgical treatment.

In choosing a method to fit the condition, in those patients seen in the early stage of the disease, in whom thyroidectomy is not justifiable, the ligation of the superior thyroid arteries and veins on both sides seems to bring about a rapid cure. This method is also free from the possible risks of hypothyroidism from removal of the gland. It is successful in most instances, and can be followed later by removal of a portion of the gland, if a recurrence of the symptoms should make it necessary.

In about two-thirds of the cases seen by the surgeon the operation for the removal of the larger lobe and isthmus can be undertaken without undue risk. In at least one-fourth of the cases the condition is so extreme, from the continued toxic condition or from acute exacerbation, that the ligation of the vessels, as advocated by Wölfler, is advisable, at least as a preliminary procedure. In a few such cases the results are astonishing. There is a relief from all symptoms and an increase within a few months, and should thyroidectomy be then undertaken, it will be done with much less risk than the former procedure of ligation. These operations we designate—*the graduated operations for hyperthyroidism*.

Some patients are in such an extremity that preliminary treatment by heart-tonics, diuretics, *x-ray* applications, and absolute rest is necessary before even the resort to ligation of the vessels is advisable.

Patients who have developed the symptoms of Graves' disease upon a previously existing goiter are usually fair risks for the operation *thyroidectomy*. The condition designated as *unilateral ex-*

ophthalmic goiter is also readily treated by enucleation of the offending encapsulated adenoma. Myxedema or hypothyroidism as a terminal stage of hyperthyroidism may be treated by the removal of the gland, to the discredit of the surgeon, when the gland is already lacking in secretion.

OPERATIVE TECHNIC

Ligation of Vessels.—A transverse incision is made in a skin crease crossing the thyroid cartilage, and the wound is deepened to the gland between the omohyoid and the sternomastoid muscles. All of the branches of the superior thyroid artery are secured at the apex of the lobe in one mass ligature which includes the superior veins as well, and in some cases a bit of the upper pole of the gland. The ligature material is linen.

Incision for enucleation and excision is the transverse collar or Kocher incision. The incision is best placed midway between the thyroid cartilage and the sternum, and it includes the platysma myoides muscle, which is lifted above and below with the skin flap over an area sufficient to expose the muscles covering the enlarged gland. A vertical incision now separates the hyoid muscles from the thyroid cartilage to the sternum. In cases of adenoma to be enucleated, the fibrous capsule is now opened, the goiter exposed and incised to the depth of the adenoma capsule, which is enucleated, and the thyroid tissue closed with a locking buttonhole stitch. A temporary drain of rubber tissue relieves the tension which might occur without this provision. The wound is closed with the subcutaneous suture.

In case excision is deemed best, the sternohyoid is caught and cut between the forceps near its upper insertion, which would be above the nerve-supply. If more room is required in order to expose the upper pole and facilitate the ligation of the superior thyroid artery, the sternothyroid may be treated in a similar manner. This trap-door exposure aids greatly in the elevation of the gland, which is now incised along its outer border with the dissecting scissors and the tissues brushed down with gauze as the gland is dissected. The vessels as seen are caught in artery clamps.

This capsule is not readily removed, as it is bound to the gland at many points by the trabeculae of connective tissue which penetrate the gland. The inferior thyroid artery may, at times, be caught before it reaches the capsule. The gland is rotated over the mid-line of the neck, preserving the capsule and deeper tissues, recurrent laryngeal nerves, and parathyroid glands from injury. There seems to be but little danger from rough handling of the gland removed if the portion which is to remain is preserved from injury.

The severed muscles are united and the wound drained with spread-rubber tissue over the raw surface of the thyroid, and a tubular drain is often employed for twenty-four hours. The wound is closed as previously described.

The parathyroid bodies are four in number, as a rule, and they rest two on each side behind, or they may occasionally be connected with the capsule of the gland. These bodies should be preserved to prevent tetany, and yet it is less probable that the injury of two of them in the removal of one lobe for exophthalmic goiter would produce tetany than that the disease would follow a similar operation for simple colloid goiter, with a partial removal of the second lobe as a primary or secondary procedure.

The anesthetic of choice is ether. Cocain infiltration may be substituted if the extremely serious condition of the patient demands it, or if the surgeon prefers it, or lacks confidence in his anesthetist. If ether is used, we administer hypodermically $\frac{1}{120}$ gr. solution of atropin and $\frac{1}{6}$ gr. morphin. These drugs allay the tracheal mucus and act as a stimulus and reduce the necessity of profound narcosis by quieting the mental distress.

The patient is placed upon a table in the reverse Trendelenburg position, the head thrown back and the shoulders elevated to render the thyroid area more prominent and accessible.

After operation the patient is given one quart of saline slowly per rectum. This is repeated twice within the next twelve hours. Should intestinal relaxation be present, we consider the salines of sufficient importance to give them subcutaneously in all severe cases. The precordial ice-bag may steady a rapid heart. Atropin checks excessive perspiration and morphin quiets restlessness.

These drugs are used as indicated above. Death from operation seldom occurs after the first twenty-four hours.

The employment of the graduated operation or the above-described methods, of selecting the time, the preparation, and the choice of type of operation, with the careful after-care of the patient, has reduced the mortality from 4 per cent. to 2 per cent.

LIGATION OF THE THYROID VESSELS IN CERTAIN CASES OF HYPERTHYROIDISM *

By CHARLES H. MAYO

The surgical treatment of hyperthyroidism has apparently become accepted as a promising procedure for the relief of a most serious condition, notwithstanding the fact that many cases recover spontaneously or are cured by medical treatment.

Much of the fog which surrounded the early-day knowledge of this subject was due to a nomenclature which labeled the syndrome of symptoms with the names of various men who more or less perfectly described the condition. The earlier cases and those presenting irregular symptoms were unfortunate in being denied a classification. They were *pseudo* or *fruste* until they corresponded to those mentioned by Graves or Basedow in description of the disease as a finished product.

That this change from medical to surgical care is based upon rational grounds is evidenced by reports from the laboratories of the surgeons doing the greatest number of operations for goiter—from the clinics of Kocher, Halsted, and many others, including our own. These reports not only show the improved condition of the patients operated upon, but they are very uniform in the stated changes occurring in the thyroid in such cases, especially as to the apparent cell activity which seems to be essential to excessive secretion.

The thyroid gland is often small or but little enlarged as compared to simple goiters, and in fact often resembles them. It received less attention from pathologists than the heart or nervous symptoms, and a more careful examination was made of other

* Reprinted from "Annals of Surgery," Dec., 1909.

and associated organs than of the thyroid. As the treatment of the condition was symptomatic it was changed from time to time as new remedies were added to therapeutics.

The early surgical experience in Basedow's disease was unfortunate in the high mortality incident to the delayed surgery, complications and degenerations of essential organs often preventing a cure. Most of the operations were made as a last desperate resort, after obvious failures of many forms of medication and other methods of treatment.

While surgery of hyperthyroidism has taken a most prominent position in the treatment of exophthalmic goiter, it has advanced along various lines: (1) By operating upon the gland itself by extirpation of a varying amount; (2) by reduction of its blood-supply from vessel ligation—arterial alone, arterial and venous, and venous alone; (3) by operation upon distant organs, especially the pelvic in women; (4) by extirpation of the cervical sympathetic ganglions; and (5) more recently the injection of cytolytic serum has been added.

Greater operative experience upon cases of hyperthyroidism has led to a great reduction in the mortality. This has come about through many changes, *i. e.*, earlier operation, better operative technic, more careful preparation of patients, choosing the operation to suit the case, and the graduated operation.

The anastomosis of circulation in the thyroid is very free. When we consider that this circulation is so extensive in proportion to that of the brain that the vessels arise from points closely associated with that of the brain, with a blood-supply which cannot be destroyed except by deliberate act, and that it has free venous return, had we no knowledge of its function we could still easily understand the importance of the organ.

The earliest ligation of vessels as an operation for the relief of goiter is credited to Wölfler. Our experience with this procedure covers over two hundred operations, and with the results obtained by this method we consider that the ligation of certain thyroid arteries and veins, and at times of a portion of the gland, seems indicated in some cases of hyperthyroidism.

First, in those suffering from mild symptoms of hyperthyroidism,

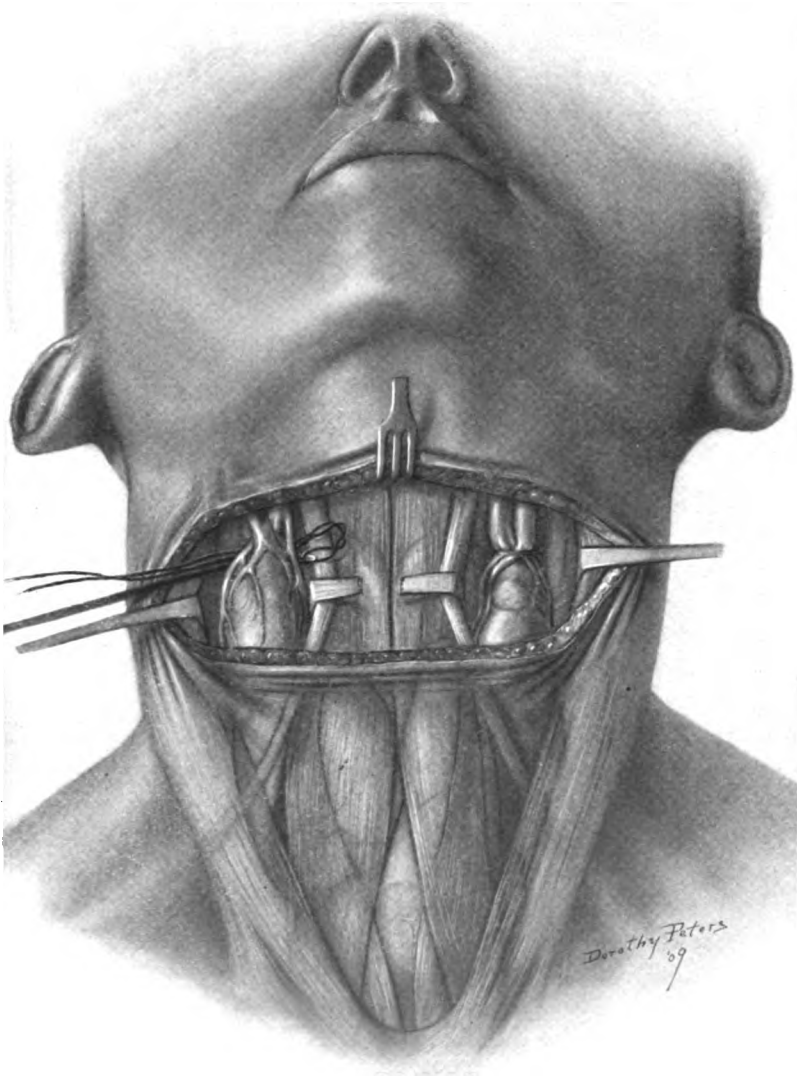


Fig. 211.--Ligation of the superior thyroid vessels.

and those in whom the diagnosis is made early, possibly before

the less important eye symptoms or even goiter is present. In cases which are hardly severe enough to warrant a thyroidectomy, the ligation of the vessels will often produce a cure in a few weeks with but little risk and without the necessity of special medication.

Second, ligation is indicated in that larger group of acute, severe exophthalmic goiters, and in the chronic and very sick patients who, having exhausted all forms of treatment, are now suffering with various secondary symptoms—dilatation and degeneration of the heart, fatty liver, soft spleen, diseased kidneys which have resulted from the chronic toxins as seen in the later stages of Graves' disease—changes which, after all, are the final cause of death. This operation is of particular value in those cases with a marked pulsation and peculiar thrill of the superior thyroid arteries.

All severe cases of hyperthyroidism, when suffering from edema, ascites, dilatation of the heart, diarrhea, gastric crisis of vomiting, should be under observation for a short time at least, and some of them for a considerable period of time, to improve their condition, if possible, before even a ligation be attempted. There is a time in the progress of these cases when terminal degeneration of essential organs has advanced so far that they are no longer curable. When surgery is applied as a last resort, it may be possible, by using some special great dexterity and care, to remove part of the gland without an immediate fatal result. While the disease may be checked, these patients are seldom sufficiently benefited to warrant the immoderate risk of an extirpation. On the other hand, at such times many cases which have at first appeared to be unfavorable subjects will so far improve under symptomatic treatment, aided by rest, hygiene, *x-ray*, etc., as to become suitable operative subjects at a later period. It is in this class of cases that ligation as a preliminary procedure is of great value. The relative safety of ligation as compared with that of thyroidectomy may lead the operator to accept as surgical risks patients so far advanced in the disease as to have but little prospect of cure. In operating upon these cases the surgeon should use his judgment as to the time and method of operation, the anesthetic to be used,

and from observations according to the improvement manifest under preparatory treatment.

Anesthetic.—The choice of an anesthetic must be left to the individual surgeon, but the immediate surroundings and the ability of the assistants may often modify conditions. Some surgeons like the use of chloroform, others gas and oxygen. We prefer ether on the open mask. Occasionally there are advanced cases in which we use local anesthesia— $\frac{1}{10}$ of 1 per cent. solution of cocain in normal salt solution—beneath the skin, to create edematous tissue. A hypodermic of morphin sulphate, gr. $\frac{1}{8}$, and atropin solution, gr. $\frac{1}{100}$, is given thirty minutes before general anesthesia is used. The more restless, nervous, and hysterical patients do well with scopolamin morphin, $\frac{1}{200}$ to $\frac{1}{100}$, one hour preceding the operation, with local anesthesia.

Operation.—A transverse incision gives the best working space as well as the least disfiguring scar. It is made $2\frac{1}{2}$ inches in length, crossing the central part of the thyroid cartilage. The incision should be made in a natural skin crease if possible, and should include the platysma myoides, this one incision being better than two lateral. The inner border of the sternomastoid is tracted laterally. This exposes the omohyoid muscle, which is tracted up and in toward the midline. Beneath this muscle is the upper pole of the gland with the superior thyroid artery and vein.

The ligating material is linen passed by an aneurism needle. Should a vein be pierced and a hemorrhage follow the placing of the ligature, it is tracted upon, and a second loop is passed around including more tissue. In most cases this is preferable to a more generous incision with freer dissection. The veins are purposely included to secure venous obstruction, the free anastomosis within the gland capsule making this of advantage. One need not fear the ligation of a nerve in this location, as the inferior or recurrent laryngeal is below. The wound is closed by a subcuticular suture without drainage.

The location of the ligation at the pole of the gland is important, as in one of our cases, in which the superior thyroid arteries had been previously ligated at a point where they were given off from

their origin at the external carotid, there was but partial and temporary relief. At the second operation we found a reversal of the circulation in the large inner branch anastomosing with the inferior thyroid, and in the upper part of the gland the circulation was but little reduced.

The after-care of these patients is according to the severity of their symptoms. Rest in bed, slow saline by rectum often repeated. Patients will usually absorb several quarts of the solution within twenty-four hours, but should they be subject to diarrhea the rectal saline may not be possible. In such cases, if from the severity of the symptoms it is especially desirable to use salines, they are given subcutaneously.

Most of the patients are in a serious condition when operated upon, and a few develop very alarming symptoms. For these, scopolamin can be given in doses varying from $\frac{1}{200}$ to $\frac{1}{150}$ to control the great muscular restlessness, and injections of strophanthin and digitalis may be used with caution. Adrenalin will slow the pulse, but should be used with care at this time because of the strain upon the heart muscle. Camphorated oil, 10 to 15 minims hypodermically, is a useful stimulant. An ice-bag over the pericardial region is of benefit. The danger after operation continues for several days in the more severe cases.

Not only is the body charged with excessive secretion, but as the gland contains at the time of ligation much secretion for absorption, therefore the general progress of these cases toward recovery is not so rapid as where a definite quantity of the gland tissue can be removed.

In the large hard glands of hyperthyroidism, where some reversion has occurred with colloid deposit, ligation is not indicated.

Changes in the gland after ligation are most interesting. There is a change from the great increase in cell development back to a condition of simple goiter. This is produced by a simple exfoliation of cells and does not resemble the degenerative changes which are found in the glands removed in the late stages of Basedow's, or those in which serum treatment has been used. In both of these there is a true cytolysis or chemical destruction of the cell.

Five hundred and eighty patients suffering from hyperthyroidism or exophthalmic goiter have been operated upon at St. Mary's Hospital. Of these, two hundred and twenty-five were ligations of the superior thyroid arteries and veins. A number of these ligations have been made too recently to base observations upon except as to the immediate risk of operation, which is about 2 per cent. in deaths occurring within a few days. Ten of these cases were operated upon too late and did not improve, but continued in their downward progress, dying in from eight to ten months later of their disease. In these deaths is included a case of pernicious anemia.

We now have full records of one hundred and thirty-eight cases which were ligated sufficiently long ago to make their report of value.

There were twelve cases of ligation of the remaining superior thyroid artery and vein following thyroidectomy of the larger lobe and isthmus, the primary operation being followed by relapse after one or several years, with growth of the remaining lobe.

Twenty-eight cases of thyroidectomy followed the ligation of both superior thyroid vessels. Although all of them were very severe cases at the time of ligation, there was no mortality from the second operation.

In cases of ligation without thyroidectomy the results were as follows:

	CASES
Slight improvement.....	9
Great improvement.....	44
Very marked improvement.....	11
Absolutely well.....	4
Cases of questionable exophthalmic goiter, no improvement.....	9

Of this latter type there are two classes: (1) Some peculiar cases of myocardial trouble, and (2) those in which the nervous symptoms predominate. Both classes are associated with other symptoms of hyperthyroidism. It is possible that in some of these the symptoms come from changes in other ductless glands, especially the suprarenal; as yet they remain to be better described.

While many patients reported indefinite gain in weight, there

were sixty-eight cases in which an accurate report was given, showing that sixty-two patients gained an average of 20½ pounds from three to five months after operation. If cases were excluded that were about normal weight at the time of operation the average gain would exceed this. Six patients lost an average of 6 pounds. Most of these were but little reduced at the time of operation.

In the majority of cases the ligation is made as a definite step in a graduated operation to reduce excessive secretion of the gland, and some of the reported cases are yet to be operated upon for the removal of part of the gland as a secondary procedure. Some of the patients in this series consider themselves too well at present to undergo another operation, and will probably do so only under the stress of a relapse of their symptoms, when it may be advisable to ligate the right inferior thyroid artery as a second step toward thyroidectomy. We found this procedure of value in nine cases. On several occasions, because of the various seemingly urgent reasons involving the safety of the patient, we deemed it advisable to convert a thyroidectomy into a ligation of vessels.

THE REVERSION THEORY AND CLASSIFICATION OF GOITER *

BY WM. CARPENTER MACCARTY

I.

In making a daily study of goiter, grossly and microscopically, in the fresh and fixed condition, after examining specimens from seven hundred cases, with their histories, and after reviewing the literature, which recently has become extensive, I have been impressed by the variance of the opinions and also the variance in the methods of attack in the study of the etiology.

The symptomatology seems, at least in well-developed cases, to be clearly known, and is well summarized in recent articles, such as those of Barker, Kocher, Halsted, Mayo, and others. I feel that there are early cases which are not diagnosticated as soon as they should be, because the symptoms are not associated with noticeable external glandular enlargement; it behooves the examining physician, therefore, to consider the possibility of hyperthyroidism in all cases of tachycardia and extreme nervousness. Such a diagnosis, however, does not mean surgical treatment always, although it is often in these early cases that complete recovery is seen following operation.

Briefly it may be stated that the etiology of hyperthyroidism is still far from being satisfactorily explained. Before beginning the study of goiter, we must first consider the normal biology of glands in general and of the normal thyroid.

If we review briefly the anatomy and function of the normal epithelial glands, such as the breast, salivary glands, and the pancreas or the liver, we find that all these start embryologically as invaginations, either of the endoderm or the ectoderm, and that the

* Reprinted from "The American Journal of the Medical Sciences," June, 1909.

anatomic and the histologic unit of these glands, with the exception of the liver, is an alveolus lined by one layer of epithelium, which hypertrophies and secretes into the alveolus. It may be further noticed that the secretion of each gland has one or more definite functions (nutritive, excretive, or protective) which are stimulated to activity either by the senses, sight, smell, taste, hearing, or touch, the sensations of which are transmitted through the nerves, or by some chemical substance* put into the circulation by some other cells in another part of the body, or by both of these means. The epithelial glands which open into the alimentary tract either directly or by ducts, as do the buccal, salivary, gastric, intestinal, hepatic, and pancreatic, have one or more of the following functions: the production of a diluent, a mucilaginous material and ferments, or at least some digestive substance.

The thyroid is an epithelial gland conforming to the above anatomic conditions, with the exception that it does not in its present condition possess a duct into the alimentary canal. We are, however, justified in believing that it probably did, at one time in the development of man, open into the canal by a duct, since most surgeons of extensive experience have operated on cysts of the thyroglossal duct, which has its origin in the gland and its opening in the foramen cæcum. Anatomically the thyroid is a well-defined gland, histologically not unlike some other epithelial glands, located near the alimentary canal, and showing at times remains of a duct emptying into it.

If such a gland emptied its contents into the alimentary tract, the contents probably had one or more of the above-mentioned functions of glands, as it is hardly conceivable, from any known facts about any other glands similarly situated, that one so located would

* See the work of Dolinsky (1895), who discovered that acids brought in contact with the mucous membrane of the duodenum set up promptly secretion of the pancreatic juice. This action was supposed to be reflexly through the nerves, but since the work of Popielski, Bayliss, and Starling, which shows that this action takes place after the nerves are severed, some other explanation has been thought of. They determined that if an extract of the mucosa of the duodenum and 0.4 per cent. HCl were made and injected into the blood, pancreatic secretion would be set up. The especial substance formed by this mixture they have called "secretin," and Starling has referred to it as a "messenger" from the duodenum through the blood to the pancreas. (Howell's "Text-book of Physiology," p. 703, and Bayliss and Starling, "Journal of Physiology," 1902, xxviii, 325.)

be without such a function. When, in the periods of man's phylogenetic history, he has been put under an environment which lacked the normal stimulus* necessary for the continuance of such an organ is not known. There was, however, a period in his racial development when this gland had a more extensive function.

This I believe to be a fair assumption from its anatomy and the facts known regarding the gradual disappearance or diminution in function of other organs, such as the loss of function in the male breast, diminution of the function of the toes, loss of body-hair, and loss of function of the appendix. Other examples may be perhaps found in the economy of the organism.

With such facts and suppositions before us, and having some knowledge of the process of reversion, as seen in organs, in plant and animal life, including man,—especially the latter, in whom we see secreting male breasts, secreting supernumerary breasts, polymastia, bicornate uteri, etc.,—it is not unnatural to think of the possible partly rudimentary thyroid as reverting to its original activity.

In case this ductless gland should revert to a more extensive activity, what would occur in it? The first evidence would probably be hypertrophy and secretion. If this occurred, two things are possible: Either there would be a cyst formation, or absorption of the products produced. These two possibilities are often seen in other organs: for example, in the liver and kidneys under obstructive conditions. In the liver the backing up of the secretion causes dilatation of the ducts, enlargement of the liver, but seldom cyst formation. The secretion under such pressure is supposed to get into the lymphatics, and thus into the circulation, giving evidence of this in jaundice and toxemia.

In the kidney a similar process is seen, with perhaps a greater tendency to the production of cysts. However, here too we see both conditions in which there is also reabsorption of the products of secretion and resulting toxemia. Why the cyst formation should occur in one instance and not in another is not known.

*In calling this a normal stimulus, liberty is taken from a knowledge of the action of all the other epithelial glands in the human body as it exists now. These glands are stimulated to activity normally by certain substances under certain conditions.

These processes in the kidney and liver and other glands are very similar to those seen in the "simple cystic" goiter and the "exophthalmic" goiter. In the former case the alveoli are markedly distended and contain products the pressure of which flattens the epithelial lining and in some cases produces complete atrophy of the cells, so that the whole thyroid exists as a foreign body composed of cysts and only causing inconvenience by pressure. When, however, there is complete atrophy of the secreting surface, a condition of myxedema may occur, as we shall see later. Early in the case of "exophthalmic" goiter the material secreted is not stored in the alveoli, but is reabsorbed, and it is in these cases especially that the toxemia is seen, although toxemia does occur, as we shall see later, in some cystic goiters under certain conditions (Figs. 216 and 217).

Like the absorbed products of the kidney and the liver, the products of the thyroid produce toxic symptoms and even death, with the changes seen at autopsy which occur in other toxemias. The liver is fatty, there may be changes in the kidneys, the heart is often fatty and markedly dilated.

The clinical picture is one of toxemia with mental, nervous, and digestive disturbances. The substance or substances which produce this toxemia are the products of the thyroid, since their associated iodine has been demonstrated in the blood of patients suffering from hyperthyroidism. Similar symptoms can be produced experimentally by the overfeeding of the products of the thyroid. Removal of the greater portion of the secreting gland reduces the symptoms and often causes them to disappear completely. We must, therefore, consider the toxin, so to speak, as being the product of the gland itself, just as the toxic substances in the cases of the kidney and liver are products of their own secretion.

In the case of the thyroid, however, a certain amount of the secretion is apparently necessary for the well-being of the individual, because we see death following total extirpation of the gland. These cases go on to a condition of myxedema which can be relieved by feeding the products of the gland.

In the condition of cretinism, in which there is an absence of thyroid secretion and a concomitant physical underdevelopment,

great improvement may be seen after thyroid feeding. All of these examples seem to demonstrate the possible physiologic necessity of the products of the thyroid. The contrast between a patient with hyperthyroidism and one with hypothyroidism is very marked, the conditions being clinically quite opposite, in that one is the subject of extreme activity, while the other is the subject of extreme apathy or sluggishness. The necessity of the thyroid for the economic equilibrium has two possibilities for its solution. Either the products normally secreted are reabsorbed, or there is an "internal" secretion. The whole problem of internal secretion is one about which we are not so absolutely certain, unless we give it a very broad meaning, in that each organ really contributes something to the body-fluids which is characteristic of itself. This is perhaps a correct meaning, in view of the results obtained from the studies of immunity. It must not be forgotten that the internal secretion may be twofold, as that in the liver in which one product is for nutrition (glycogen) and the other for elimination (urea).

It may be stated that at present we are beginning to look upon the different types of goiter as stages in one general process. This is seen histologically in the type known as "exophthalmic goiter" (Fig. 215), which histologically is an exaggerated picture of the process of papillary projection formation (Fig. 217) found in some of our "colloid" goiters, which give "exophthalmic" symptoms. This is so true that in the routine examination of sections from different areas I have, for want of any definite name, in some cases written my report "colloid goiter with exophthalmic areas," or "colloid, fetal, and exophthalmic goiter," recognizing in these specimens all three types well developed. At times it is possible to demonstrate areas which are absolutely typical "exophthalmic goiter," and in other areas find typical fetal adenoma and typical "colloid" goiter. These findings have led Dr. Wilson and me to believe that the so-called "types of goiter" are not "types," but "stages." Why one thyroid should develop into a cystic or "colloid" goiter and another into an "exophthalmic" goiter is unknown, just as the process of cyst formation and its counterpart, the absorption without cyst formation, in the kidney and liver, are unknown.

In view of the fact that the thyroid is an epithelial gland, producing a secretion which seems necessary for the body economy, and that this secretion was most probably emptied into the alimentary canal through a duct, the question of the normal stimulation of this activity naturally presents itself, since we know that all the other epithelial glands act as a result of some type of physiologic stimulus.

The question arises: What was the normal stimulus for the thyroid under its original conditions? and would the same thing stimulate it again to activity under a condition of reversion, as we see it in the supernumerary breasts? I have recently had a case of a woman who was brought to the clinic with a diagnosis of lipomata in the axillæ, which when removed proved to be functioning supernumerary breasts without ducts, there being absolutely no sign of nipples. These tumors appeared at puberty and had recently become markedly hypertrophied during pregnancy. We have in this case breasts which are rudimentary and ductless, stimulated to activity by the natural stimulus for the natural breast activity. The patient was otherwise normal. The breasts upon microscopic examination presented the picture of normal breasts with the exception that the acini were markedly dilated or cystic, and contained a somewhat thickened milk. The interglandular tissue, especially that immediately surrounding the alveoli, was infiltrated with lymphocytes.* It is these facts and the analogy of the thyroid to other glands and their activities which led me to the reversion hypothesis for the condition known as goiter, without attempting to state the real etiologic stimulus.

May the process known as goiter be expressed as an attempted reversion of the thyroid to its original function, being stimulated to activity by the same substance which stimulated it to activity in primitive man? What this stimulating substance is, where it is

* Often associated with the process of absorption is seen a round-cell infiltration. This condition in goiter has led many to conceive of an etiologic process of an infectious nature. This round-cell infiltration has been found in thyroids of individuals who have given no history of having any symptoms of hyperthyroidism or enlargement of the gland, although I may suggest that perhaps a great many individuals undergo some symptoms of hyperthyroidism unnoticed and perhaps unrecognizable in the thyroid microscopically.

found, and how it stimulates the gland to activity is unknown.* Whether this factor is organic or inorganic, living or dead, is left to the etiologists. In presenting such a theory it seems to me that it may stimulate further investigation, not only among medical men, but among biologists generally.

The physiologic chemist has a great field before him in determining the source in the intestinal contents, either as a substance taken into the tract or as a result of breaking down or synthesis of organic or inorganic substances. He may also busy himself with the products of metabolism found in the fluids of the body which may contain the substance or living thing which causes the hypersecretion of the organ. Perhaps such an hypothesis may open a new field of research; it is with this view that I have taken the liberty of publicly expressing it.

II.

In classifying and recording my observations on the material in Drs. Mayo's clinics I have found the following scheme of value, not only to the pathologist, but especially to the clinician. For their convenience I have tried to state the conditions, "types" of normal thyroid and goiter, as we know them. The following classification has been adopted as the simplest, and represents the histologic types or stages of goiter, from which the clinical picture may be deducted.

The fetal thyroid (Figs. 212 and 219a) contains no histologic visible secretion so far as we know, and yet it is the forerunner of

* The stimulation of glandular activity, while it is not clear in most cases, shows itself dependent upon normal conditions. The mammary glands, for example, are stimulated to hypertrophy and secretion during pregnancy by some influence started in the female pelvic viscera. What this is or how it acts is unknown. The glands of the stomach are stimulated to activity by the sensation of eating (psychic), by stimuli in the mouth and nostrils. It seems (Howell's "Text-book of Physiology") that some foods contain substances capable of affecting the secretion, and that "meat extracts, meat juices, soups, etc., are particularly effective in this respect." Howell says that "certain common articles of food, such as bread and white of eggs, have no effect of this kind at all." He speaks of the "mechanism of secretion," and divides it into groups: (1) The psychic secretion; (2) the secretion from secretagogues contained in the food; (3) the secretion from secretagogues contained in the products of digestion. He makes the statement that the chemical nature of these last named stimuli is undetermined. One may clearly say that all glands in the human body are stimulated to activity by something which has to do with the body economy.

some of our goiters (fetal adenomas) (Fig. 218) which retain the fetal type. Diagrammatically it may be represented in Fig. 219*a*). The "normal" thyroid (Figs. 213 and 219*b*) is composed of alveoli

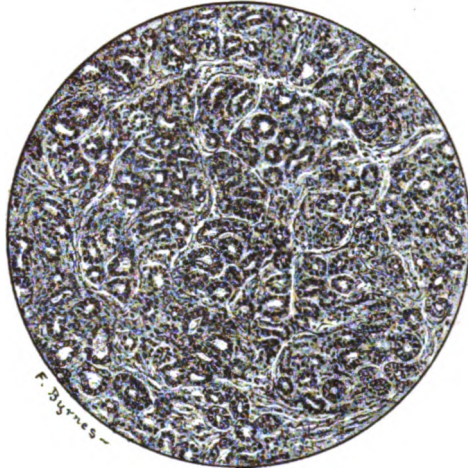


Fig. 212.—Fetal thyroid.

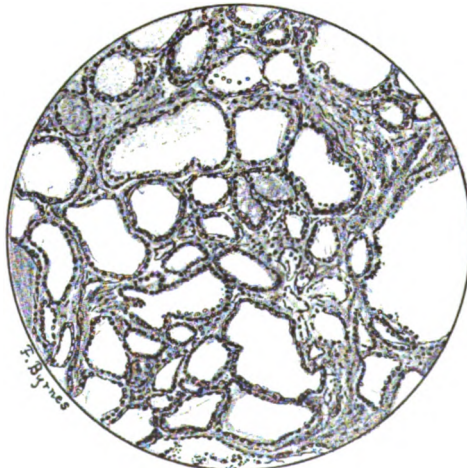


Fig. 213.—"Normal" thyroid.

lined by one layer of epithelium; it secretes some substance, and contains a probably partially non-absorbable substance known as colloid, some of which at least remains in the alveoli. In the

“simple goiter,” or cystic goiter (Figs. 214 and 219c), in which the alveoli are large and filled with colloid, there is an excess of secretion and production of colloid without an equal amount of absorp-

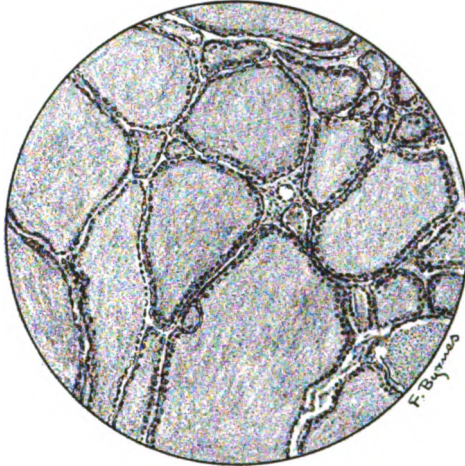


Fig. 214.—Cystic thyroid.

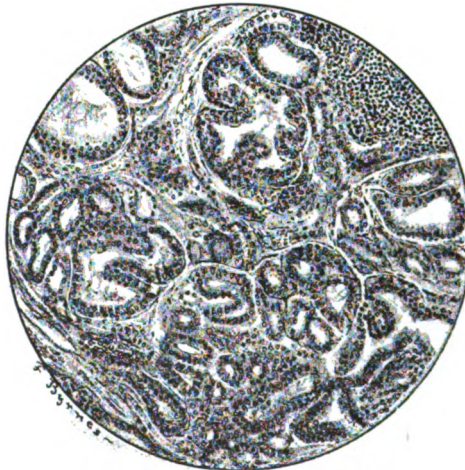


Fig. 215.—Hypertrophic parenchymatous goiter.

tion, and the condition may be represented by Fig. 219c. This type corresponds to the cystic kidney which gives no symptoms but is still functioning, and is compatible with the life of the

individual. In the type known as "exophthalmic goiter" (Figs. 215, 219*d*, and 219*e*) there is an excess of secretion and increased absorption, with slight, if any, increase in colloid production. This

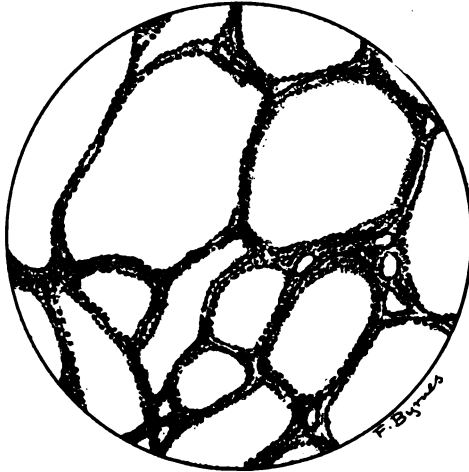


Fig. 216.—Cystic Goiter.



Fig. 217.—Papillary cystic goiter.

type corresponds to the condition in the kidney and liver in which there is absorption without cyst formation or partial cyst formation.

There may also be a stage in which the symptoms are very

excessive, and in which, histologically, an extreme cytolysis is seen. We have a condition, therefore, of extreme excess of the products of the degenerating cells with increased absorption, which, however, may not necessarily be equal to the amount of secretion. This



Fig. 218.—Fetal adenoma of the thyroid.

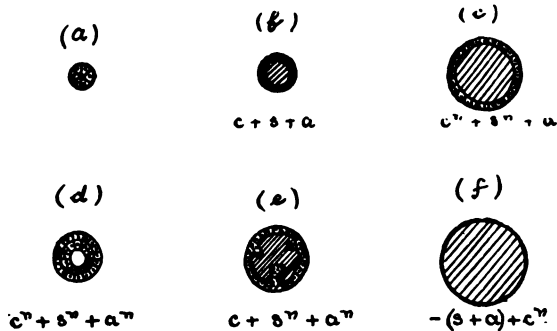


Fig. 219.—Diagrammatic representation of *a*, the fetal thyroid; *b*, normal thyroid; *c*, cystic goiter; *d*, hypertrophic parenchymatous goiter; *e*, papillary cystic goiter; and *f*, the cured type of cystic goiter. In the algebraic representation of the conditions, *c* equals colloid production; *s*, absorbable secretion, and *a*, the process of absorption. Any of these may be increased in the conditions, and this is represented by raising the letter to the *n*th power.

may occur in the papillary cystic (Fig. 217), hypertrophic parenchymatous (Fig. 215), and fetal adenoma (Fig. 218).

There is still another stage, which may be termed the cured stage (Fig. 219*f*); cases which have withstood the overgrowth and excess

of secretion and cytolysis until there remains a large tumor composed of alveoli, lined by thin connective-tissue or atrophic cells instead of healthy epithelium, and filled with colloid material. These patients suffer only the inconvenience of a tumor without the toxic effect. True enough, however, some of these go on to myxedema as a result of the lack of secreting surface. This condition is really a minus condition, or a condition of hypothyroidism (Fig. 219f). It may be well compared to the hydronephrotic or cystic kidney, which has little or no functioning surface. These types or stages are those which we recognize both histologically and clinically.

If we assume that the thyroid has a more extensive function in primitive man than it has at present, and we are from analogy perhaps justified in making this assumption, we must endeavor to express the condition in primitive man.

First, however, the human organism to-day contains a "normal" thyroid which represents colloid production, an absorbable secretion, the process of absorption, and no excretion into the alimentary canal. The welfare of the organism is dependent upon its food-supply, the process of digestion, and air, and would live advantageously if it were not for the entrance of antagonistic organisms or substances through the portals of entry, the substances which arise in the intestine, or as a result of metabolism. Normal man and his relations to his thyroid may be expressed by saying that he has air, food-products (including water), the process of digestion, and a glandular organ (thyroid), which produces colloid material, an absorbable secretion, and shows the process of absorption, but does not empty its secretion into the alimentary canal.

Primitive man had air, food-products (including water), the process of digestion, and a glandular organ (thyroid) which produced a secretion which was excreted into the alimentary canal, because we assume that his relations to the thyroid were only different from the present relations in that the thyroid had a more extensive function and emptied its secretion through the thyroglossal duct into the alimentary canal, where it probably had some function which does not exist as such, at least to the same extent, in present-day man.

From a knowledge of the process of secretion in other glands based upon experimental evidence, such as the experiments upon the duodenum with hydrochloric acid, which produces some substance which gets into the circulation and thus stimulates the pancreatic and hepatic secretion, and the process of secretion in the breasts as stimulated by the developing *fetus in utero*, and perhaps also the increased secretions of the salivary glands, which may have some chemical stimulus, I have been led to consider a somewhat similar process in connection with the original normal activity and the abnormal activity of the thyroid gland. What the stimulating thing is, living or dead, organic or inorganic, is at present not known. The possibilities may be briefly stated as follows: (1) The stimulating something may be in the food-products (including water); (2) it may be in the products of metabolism; (3) it may be in the air which the individual breathes; and (4) in accordance with the hypothesis of this paper the unknown stimulating substance is supposed to be the unknown substance which stimulated the gland to activity in primitive man, it acting in cases of goiter upon a rudimentary gland.

Without regard to the etiologic factor or the nature of the process in goiter, but for the use of the pathologist and clinician, the material which I have studied may be grouped under simple convenient headings. The terms "exophthalmic" goiter, "colloid" goiter, and "simple" goiter, etc., have no very definite histologic meaning, nor have they any definite clinical meaning as we now understand the conditions. We should attempt, therefore, a classification based upon pathologic findings in exophthalmic goiter which have been well worked out by my colleague, Dr. Wilson, and the other types as worked out from my observations.

The "simple" goiter or "colloid" goiter which we recognize clinically as an enlargement of the thyroid without symptoms other than pressure, should properly be called a cystic thyroid or cystic goiter (*thyroidea cystica*) (Figs. 214 and 219c), because the tumor histologically is composed of multiple small or large cysts with their contents. The term "exophthalmic goiter" is based upon one clinical sign, exophthalmos, which is not constant in cases of

hyperthyroidism. On the other hand, there are cystic goiters which sometimes show exophthalmos, and hyperthyroidism with or without exophthalmos.

There are two conditions connected with the "exophthalmic goiter," as it has heretofore been generally although not commonly understood, which seem positive. One is the histologic picture of increase in the epithelial or secreting surface of the gland, and the other the clinical condition, hyperthyroidism. Histologically, therefore, this stage may be termed hypertrophic parenchymatous goiter or thyroid (*thyroidea parenchymatosa hypertrophica*) (Figs. 218 and 219*d*). There is little or no cyst formation, but only a hypertrophy of the parenchyma.

A third type or stage is clinically and histologically the cystic goiter, which at some period develops symptoms of hyperthyroidism, and which histologically shows the cysts filled with colloid material as in the cystic goiter, with the addition that there are papillary projections into the lumina of the alveoli with consequent increased secreting surface, therefore approaching the hypertrophic parenchymatous goiter histologically and clinically. This type may be the papillary cystic goiter or thyroid (*thyroidea cystica papillare*) (Figs. 216 and 217, and 219*e*).

A fourth type or stage is that one seen histologically as a hypertrophic fetal thyroid, in which there is a small amount of epithelial tissue and a great amount of interglandular connective tissue. Clinically, this type is the goiter of the cretin with tumor formation and hypothyroidism. We shall call this condition hypertrophic fetal thyroid (*thyroidea fœtalis hypertrophica*).

A fifth type and a more common type than the last one is the fetal adenoma or adenomatous hypertrophy of fetal thyroid instead of the connective-tissue hypertrophy seen in the last type. This type clinically is seen usually as a tumor, which may or may not cause any other inconvenience than that of pressure. It usually is an encapsulated tumor in the thyroid, and can be shelled out. However, when the encysted or encapsulated fetal adenomata occur, the tissue may degenerate from some unknown reason, or perhaps from circulatory changes due to the thickened capsule, and then

the products may be rapidly taken up by the lymphatics and thrown into the circulation, giving symptoms of hyperthyroidism. This type may be termed fetal adenoma of the thyroid (*thyroidea foetalis adenomatosa*) (Figs. 218 and 219a).

Résumé.—1. The process of goiter may be a process of reversion of the thyroid gland to some former function.

2. Hyperthyroidism is a toxemia the result of absorption of the product of the hyperactive thyroid.

3. The stimulus causing the hyperactivity may be the same that stimulated the thyroid to activity in primitive man.

4. This stimulus was then probably a normal stimulus to the gland, just as we have normal stimuli for glandular activity in man in his present condition.

5. This stimulus may still be present in the food or water, formed through some process in the intestine or in the metabolism of the body, or it may exist in the air.

6. The types of goiter are probably not types but stages in a general process.

7. Goiter may be classified upon a pathologic basis as follows: (a) Cystic goiter (*thyroidea cystica*) (Fig. 214); (b) hypertrophic parenchymatous goiter (*thyroidea parenchymatosa hypertrophica*) (Fig. 215); (c) papillary cystic goiter (*thyroidea cystica papillare*) (Figs. 216 and 217); (d) hypertrophic fetal thyroid (*thyroidea foetalis hypertrophica*); (e) fetal adenoma of the thyroid (*thyroidea foetalis adenomatosa*) (Fig. 218).

8. Hyperthyroidism always occurs in *b* and *c*, and may occur in *e* (Figs. 215, 216, 217, and 218).

HEAD AND EXTREMITIES

PERIPHERAL VERSUS INTRACRANIAL OPERATIONS FOR TIC DOULOUREUX*

By CHARLES H. MAYO

The effectiveness of remedies for the cure of a disease is usually in inverse ratio to the number; and of all diseases that are not fatal, probably facial neuralgia is one of the most distressing and one of the most difficult to cure.

The pathology of this complaint we will not discuss, but it is probably an ascending change in the periphery of the nerve, which may be entirely in its vascularization. Removing the ganglion prevents regeneration. The changes in the ganglion, claimed by some observers, may not ultimately be proved, otherwise only intracranial operations would be indicated.

As in other diseases which exhibit natural remissions, undeserved credit is occasionally given to remedies because they were being used at the time the improvement occurred. We will not attempt to enumerate the great number of drugs employed for the relief or cure of neuralgia; most of them had a purely empiric origin. Those most commonly used are castor-oil, strychnin, and atropin.

The external treatment of the disease has been almost as varied as the internal; all manner of application of heat, cold, drugs, liniments, and lotions having their testimonials of cure. Electricity is employed in the form of electrolysis and high-frequency current. The Röntgen ray has been used, as well as thorium and radium; De Courmeller reporting three cases benefited by the latter method.

The number of surgical and semi-surgical methods for the relief of this trouble are probably greater than were ever advanced for

* Reprinted from "Surgery, Gynecology, and Obstetrics," Dec., 1906, pages 731-733.

the cure of any other disease. Of the methods which are supposed to exert a favorable effect upon the nerve, we mention Desplat's injection of air into the tissues supplied by the nerve branch involved. The air requires a few days for absorption, and then the treatment is repeated.

A. H. Ferguson has had good results follow the injection of salt solution into and about the Gasserian ganglion by a long hypodermic needle. It is possible that the injection of boiling water into and about the foramen of peripheral exit of the nerves might also be of benefit, after the method of Wyeth in the cure of large angioma. The use of osmic acid in 1.5 per cent. solution injected into and about the nerve, as advocated by W. H. Bennet and described by J. B. Murphy and numerous others in reports of cases benefited, shows that fearless surgeons are constantly on the lookout to secure some safe and simple method of relief. Ligation of the common carotid has been done, as well as removal of the upper sympathetic ganglions. In those cases which were reported *early*, the benefit was as marked as that often noted in the reports of surgical treatment of epilepsy.

While the motor nerves require a favorable opportunity for reunion, it is a most difficult matter to *prevent* the regeneration and return of function of the sensory nerves. For instance, in the dissection of glands of the neck, a cut spinal accessory requires careful approximation; the bundle of sensory cervical nerves, on the contrary, can all be removed, yet sensation usually returns in a few months.

The impulse of the motor nerve being outward from the center, the peripheral end degenerates, but not so much if mixed with sensory fibers, in which case the function is from the periphery to the center; the nutritive cells in the sensory fibers being ganglionic, while in the motor nerves they are central and in the cord. J. B. Murphy's work on the regeneration of the nerves shows that repair occurs where there is an axis-cylinder covered by the sheath of Schwann; that without this neurilemma there is no repair, as in the brain and upper cord structures.

Of those operations which were directed at the nerve affected,

we have stretching the nerve, and this was done as early as 1748. As a method, it gives such a brief respite that it is not warranted. Division is but little better, as union is very rapid. Resection of a portion of the nerve according to the degree of separation interposes difficulties of regeneration, yet restoration of function usually occurs in from six months to two years. J. Ewing Mears recommended the removal of the Gasserian ganglion in 1884, and this was carried out by Rose in 1890.

To accomplish the removal of the upper or supraorbital branch an incision is made in the eyebrow, or just below it, and the nerves are sought for as they pass over the supraorbital origin. They are torsioned after Thiersch's method, which winds the nerve on a blunt forceps by rolling on the forceps one half turn or less to the second of time, making the distal and the proximal portions of the nerve pull against each other at the margin of the bone. We usually wind one way until tight, and then roll in the opposite direction and repeat.

The infraorbital may be removed by many methods. Among them are those made by lateral incisions with resection of zygoma, resection of malar bone, tunneling the superior maxilla through the antrum, exposing on the floor of the orbit, and deep subcutaneous division with a small knife at the back of the orbit, the anterior portion of the nerve being withdrawn. It is also readily exposed for torsion removal at its exit from the infraorbital canal about $\frac{1}{4}$ inch below the mid-point of the infraorbital margin.

The inferior maxillary nerve is removed externally by deep dissection beneath the angle of the jaw (Sonnenberg's operation), exposing the nerve where it enters the dental canal. Another method is by lateral incision over the ramus and notching the bone or trephining and torsion removal of the nerve, and this is also done in the line of the canal or at the mental foramen. At the latter point it can be removed from the mucous side.

The intrabuccal method of Paravicini exposes the nerve from within the mouth by opening the mucous membrane back of the last molar tooth, and, by keeping close to the bone, the nerve is sought for where it enters the foramen of the dental canal of the

ramus, a sharp spine of bone marking the opening. The gustatory is easily found on the lateral floor of the mouth by drawing the tongue out and to the opposite side. The nerve can be felt as a tight cord passing laterally from the jaw to the tongue, and is exposed by merely perforating the mucous membrane and hooking it up. It is removed by the same windlass method as before described.

The methods of intracranial removal of the Gasserian ganglion are numerous, and have been well worked out by many surgeons—Hartley and Krause in the early development, and, more recently, by Cushing, of Baltimore. It is needless to tell those surgeons who have had experience with the intracranial operations that it may become one of the most tedious in surgery; again, it may be exceptionally easy. Krause, at the time of his report of twenty-seven operations and three deaths, says that the time required for the operation is from one and three-quarters to three hours, and this has been our experience with the method. Various reports give the mortality at from 10 to 15 per cent., and over 5 per cent., from various causes, are not completely cured of the disease.

It is not the purpose of this paper to decry the intracranial type of operation, as it must often be employed where other methods have failed, and in certain cases, especially in involvement of the supraorbital. The method may also be used as a primary operation when all the branches are involved. It is our experience that the cases in which the supraorbital is implicated are almost impossible to cure by peripheral operations, the several branches of the upper trunk not being removed. This is also true of the buccinator nerve, a branch of the third division passing to the angle of the mouth.

Many cases come for relief having only one branch, or at most two branches, involved. These patients are not ready to have, nor can some of them be induced to have, an intracranial operation to remove the ganglion. Others, who should have the ganglions removed, wish to try some simple although less reliable method first.

Abbe, ten years ago, advocated the intracranial implantation of

rubber tissue to cover the foramen of exit of the various branches of the trigeminal after their resection. This effectually prevented the regeneration or reunion of the nerves, and a further report was made in 1903, showing permanency of cure.

Shortly after the original report of Abbe was made, the writer, accepting the idea of interposing mechanical difficulties to the nerve union, had occasion to try the following method. In an operative case, after making a removal of the infraorbital, in which this branch alone was involved, he plugged with silver the foramen of exit. At various times since, silver screws were used to plug the foramen of peripheral exit of the second branch when removed; later, the method was applied to the inferior dental nerve.

The first case remained entirely well for seven years, when the patient had a few twinges of pain, and within a few months recurring attacks became quite severe. Osmic acid was then injected about the foramen of exit, which gave relief for six weeks, when a recurrence of pain brought him again to the operating-table. Incision showed that the silver plug, being too smooth to be firmly fixed, had come out of the canal and rested at the side of the opening. The nerve was as large as at the first operation. It was again removed by Thiersch's windlass method, and the opening plugged with a silver screw, using an ordinary screwdriver for the purpose. This patient has had no pain since, now over a year. No case with the screw inserted has complained of the nerve blocked, and some have been thus obstructed several years.

In some cases, but not extending over so long a period, the inferior dental canal has been opened externally about the point where it passes from the ramus to the body of the bone, the nerve extracted, and the canal plugged with lead. Soft silver or amalgam could be used.

In all cases the gustatory is removed, whether complained of or not, as we believe it is a possible source of reflex irritation upon the branch causing the pain.

Although there are a large number of branches from each division of the trigeminal, it is quite common that the infraorbital may alone be affected. The inferior dental may be associated with

it without the orbital nerve being implicated, or any other branches of the second and third divisions. Peripheral operations with closure of the canals are indicated in such cases.

In patients in whom the intracranial operation is made, the surgeon should have at hand a thin lead or silver plate, which should have a projection to drop into the foramen ovale to maintain

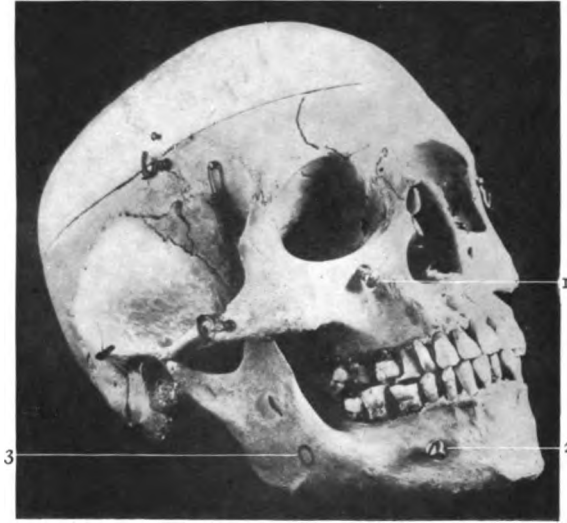


Fig. 220.—1, Screw in infraorbital canal; 2, screw in mental foramen; 3, trephine opening if canal is plugged.

its position. The plate should be of such size and shape as to extend over the foramen rotundum. In the few cases in which the removal of the ganglion presents unusual difficulties, such a plate can be inserted after section of the nerves, or if not at hand, the rubber tissue should be used to obstruct the foramen.

These operations are classed under the head of minor surgery with little disability.

THE TREATMENT OF CANCER OF THE FACE, HEAD, AND NECK *

By E. S. JUDD

This discussion is intended to give a preliminary report and an outline of the most satisfactory methods of dealing with cancer as it occurs in the region of the face, head, and neck, basing the treatment on the pathology, methods of extension, lymphatic invasion, and metastasis.

Carcinoma and epithelioma of the face, head, or neck kill the patient either by local extension or by secondary involvement of the lymphatics, and very seldom does a patient with a primary growth about the head die from cancer embolus and metastatic growths in distant organs. It is not an uncommon circumstance to see a patient who to begin with had a small ulcer on the eyelid or side of the nose, which after several years' growth had destroyed his eye and most of the tissues of the side of the face, finally die from extension by ulceration through the bones, and involvement of the meninges and brain, but at no time was there evidence of trouble in any distant organ. In a study of 4500 cases made by Hitchings for Crile, secondary cancer foci in distant organs and tissues were found in less than 1 per cent. in these cases.

Because of these facts we are certainly justified in employing radical local treatment, knowing that if we eradicate the trouble at the point affected the patient will be cured, and if we do not eradicate it, the recurrence will appear at or near the site of the primary focus. According to Butlin, and from our own experience, this reappearance will make it many times more difficult to cure the patient.

* Read before the Minnesota Valley Medical Society, December 8, 1908. (Reprinted from "The St. Paul Medical Journal," March, 1909.)

An incomplete removal of a malignant growth from any tissue, no matter what method is employed, will only help the growth along, and do more harm than good.

Face.—The parts of the face that are more frequently attacked by carcinoma or rodent ulcer are those which lie above the line of the mouth, particularly the nose and eyelids, and the part most frequently attacked by the epithelioma or squamous-celled carcinoma is the lower lip.

The rodent ulcer is more common in older people. It occurs about equally often in the male and female. The epithelium of the face, from being constantly exposed, is especially prone to this form of trouble, and although it occurs usually as a single ulcer, cases have been reported, and we have seen several, where there are many ulcers on different parts of the face. The growth starts as a wart or plaque and may remain as such for many years, though usually from constant irritation by pricking or handling it extends, the edges become raised and the base slightly indurated. Then the central part breaks down and remains an open ulcer, covered part of the time by a scab. The growth extends to the subcutaneous tissue, muscle, and bone, but usually does not involve the cervical lymphatics. Microscopically this is a true carcinoma, originating in the columnar and cuboidal cells of the glands of the skin.

If these cases of rodent-ulcer carcinoma are taken in the early stages (*i. e.*, before the induration has extended to the deeper tissues and the tumor has become fixed to the bone), practically every case can be cured, though if proper treatment is delayed and the growth irritated by insufficient application of caustics, a very small percentage will be cured in the later stages.

Many different methods, with varying degrees of satisfaction, have been described for treating this type of cancer. Arsenic paste has been used by a great many, and will cure some of the earliest cases if properly and thoroughly applied. The disadvantages of the paste are that once applied it cannot be controlled, and great destruction of the surrounding tissue may result; or more often it is used in a half-hearted way and only acts as an

irritant, helping the growth of the cancer. And if the trouble is cured by this means, the resulting scar will be much worse than it would have been by any other method of treatment.

In a recent article Pfahler and Pusey report over 70 per cent. of cures by exposures to the *x*-ray. Though but little scar follows the cure by *x*-ray, the number of treatments and the length of time required to effect a cure are often considerable, and just as good or better results come from excising.

The method of excising depends on the stage of development of the cancer. If it is fairly early and the deeper tissues are not involved, it is best to excise completely, cutting a half inch into healthy tissue, and then stitch the wound with horsehair. If the deeper tissues are invaded, as shown by the ulcer being fixed, it is best to excise the entire growth and cauterize the cut edges thoroughly with the actual cautery, and then completely remove the lymphatics draining the area. These cases frequently require several applications of the cautery, and when we are successful in eradicating the disease, it will be necessary to do a plastic operation or skin-grafting to cover the granulations.

Head.—In dealing with the squamous-celled carcinoma or epithelioma, quite a different problem confronts us. Though it is true that some early cases of epithelioma of the lip, tongue, and floor of the mouth have been cured by a slight local operation, many more have later shown an extension to the cervical lymph-nodes. This involvement of the lymph-nodes may not have shown itself for a year or more following the excision of the primary focus, and to the patient it may appear to be an entirely new trouble. If we remove the growth and instruct the patient to return if he feels any lumps in his neck, we are greatly reducing his chances of permanent cure, for all statistics show that secondary operations for the removal of the invaded lymphatics are not satisfactory and seldom curative. The records of the surgeons employing the radical operation, with the removal of the lymphatics at the same time the epithelioma is removed, show four times as many three-year cures as the same operators derive when they use the simple local operation alone.

The lip, tonsils, palate, each quadrant of the tongue, and the mucous membrane of the mouth, all have their definite lines of lymphatic drainage, and we are no more justified in leaving these glands in the presence of epithelioma than we are in leaving the axillary glands in carcinoma of the breast.

It is often best to perform these operations in two stages: At the first stage a complete removal of all glands and gland-bearing fascia; and in the second stage, the excision of the cancer. The two-stage operation is especially useful where the growth is in the floor of the mouth, or has extended on to and is involving the jaw, necessitating a removal of a part of the bone. In doing the operation in two parts the shock is less and there is not the danger of subjecting the exposed tissues of the neck to the infection of the mouth.

The prime factor in the treatment of epithelioma is an early recognition of the condition. If there is any question as to the diagnosis, it is far better to excise under local anesthesia and submit the specimen to the pathologist, than to administer potassium iodid and await developments. The prospect of cure depends almost entirely on an early operation. From 70 to 80 per cent. of the cases of cancer of the lip and tongue can be cured with almost no immediate mortality if treated early; although if the ulceration has extended to the jaw, less than 25 per cent. will be cured and about one in five will die from some complication at the time of the operation.

Dawbarn recommended ligation of the external carotids and removal of all the branches as far as possible, with the idea of starving the growth of its blood-supply, or at least delaying the development in the advanced cases. In one case in which we used this technic the pain was greatly relieved and the tumor of the upper jaw diminished in size nearly one-half, so that it was removed later. In several other cases the same treatment seemed to have no effect.

Neck.—Approximately 95 per cent. of all cancers of the neck seen by the surgeon are recurrences in the cervical glands of lesions

that appeared first at some point on the mucous membrane of the lip or mouth.

Malignant tumors of the larynx and pharynx are rare, and unless discovered at a very early stage, their treatment is not satisfactory.

Cancer of the thyroid, if it has reached the stage when it can be diagnosed as such, is beyond anything more than temporary benefit, though a complete removal of the gland in the early cases will cure a good percentage.

There are five groups of cervical lymphatic glands to be considered.

1. Sublingual: This group consists of several glands lying in close relation to the mylohyoid muscle and drains the tip and anterior two-thirds of the dorsum of the tongue and mucous membrane of the floor of the mouth.

2. Submental: A group of two to four glands between the anterior bellies of the digastric muscles, and is often the first group involved in cancer of the lip.

3. Submaxillary: This group of from three to seven glands lies along the lower border of the lower jaw and is intimately associated with the submaxillary salivary gland. Lymphatic vessels from the corner of the mouth along the margin of the lower jaw run directly to these glands.

4. Superior deep cervical group: These glands lie along the large vessels near the bifurcation and drain directly the region of the palate and indirectly the sublingual and submaxillary groups.

5. Deep cervical or supraclavicular group: These glands lie along the large vessels below the level of the omohyoid muscle. Anatomists have shown that lymph-vessels pass directly from the tongue to these glands just above the clavicle, though we have never seen this group primarily involved.

In the early cases of cancer of the tongue it should be sufficient to remove the group of glands closest to the disease. If the lesion is in, or close to, the middle line, the glands should be removed from both sides of the neck, because of the free anastomosis of the lymphatic vessels.

If any one group of glands is extensively invaded, it means

that the lymph-vessels are closed, and that in all probability cancer cells have been forced into all neighboring glands. This will be the condition when the glands are palpably enlarged and the patient comes for treatment because of a tumor in the neck. An incomplete operation with the removal of a few glands only tends to make the disease more active. The condition requires a most radical and thorough block dissection of all the glands and gland-bearing fascia, beginning at the clavicle and extending to the styloid process, in many instances sacrificing the sternomastoid muscle and internal jugular vein. Though the number of ultimate cures following this operation is not great, yet it offers much in prolonging life and relieving suffering. It is to be hoped that in the progress and development of the treatment of cancer of these regions the tendency will be toward a more careful, radical, and especially early operation, and then there will be fewer occasions for the more serious and extensive operation.

A METHOD OF OPERATION FOR UNUNITED FRACTURES *

By E. S. JUDD

In spite of the fact that there are many satisfactory methods of dealing with ununited fractures, a case will occasionally present itself in which it is almost impossible to get a bony union by the ordinary means of suturing, or by the use of splints, pegs, or with flaps of periosteum; and it is because of this somewhat rare condition that we are led to adopt our present method of treating ununited fractures.

The cause of delayed union or non-union may be a general physical condition, such as the presence of an infectious disease, a prolonged illness, central nerve lesions or malignancy, and before beginning treatment it is important to determine whether any of these conditions exist. The interference to union is most likely to be one of several local conditions, such as wide separation of fragments, overriding, interposition of soft tissues, or disturbance of the blood- and nerve-supply.

Having looked to the general condition of the patient and set the fractured ends of the bones in absolute position, we may still lack callus formation to aid union. In some instances the union is merely delayed and the development of callus may be hastened by conservative methods, such as the wearing of well-fitting splints, and stamping around on or using the extremity in order to stimulate the area to growth.

In our experience the use of Bier's congestive hyperemia, or the

* Read at the second annual meeting of the Surgical Association of the C. & N. W. Railway, Chicago, December 17, 18, 1908. (Reprinted from "The Railway Surgical Journal," August, 1909.)

injection of the patient's blood into the callus area as suggested by Von Schmieden, does not have a marked effect in the old and slower cases.

The healing of bone tissue depends upon the formation of a callus. This is developed in three parts: (1) That arising from the periosteum, or the external; (2) that which forms from the marrow-cells, or the internal; and (3) the union of these two, which is called the "intermediate."

Bone is a special tissue, as is the nerve, and there will be no callus formed unless bone is approximated to bone, *i. e.*, like tissue to like tissue. Therefore the most essential feature in the treatment of any fracture is to be positive the bony tissue of one fragment is in absolute apposition to at least a part of the bony tissue of the other fragment; and, as a matter of course, the greater the surface of apposition, the better the result.

Occasionally we see a case in which there seems to have been no attempt at bony repair, and even after open operation in which the bony tissues were set and held in direct apposition, there was no evidence of callus formation. If we exclude all constitutional causes, the most plausible reason for this condition seems to be a disturbance in the blood- and nerve-supply to the bone tissue at the time of the fracture. In our experience this condition has been observed more frequently in the humerus at the juncture of the middle and upper thirds, and in the middle third of the tibia.

It is well known that in cases of chronic osteomyelitis the shaft doubles in size from the development of new bone around the old sequestrum, and that this overdeveloped tissue gradually hardens, becoming very firm and strong. We estimated that if we could bring about a condition of chronic irritative aseptic osteomyelitis in these cases, we would not only hasten and improve the result in a great number of them, but we would also be able to get a union in the few stubborn, many times operated cases.

The technic of the operation consists of exposing the fractured ends of the bone in the usual way, then removing all scar tissue and freshening the ends of the fragments as usual. In some instances enough of the bone tissue should be removed to allow for the long

contracture of the muscles and to approximate the fragments, end to end.

To take the place of the sequestrum and to act as a stimulant to the bone-producing cells of the marrow, we place in the medullary canal a loose-fitting ivory plug, usually the handle of a cataract knife. This should extend into the canal of each fragment at least 1 inch, and should be held in place by a linen thread tied around its center and drawn out of the skin wound. It is not intended that this plug should act as a splint, and it should not, therefore, fill the entire lumen of the canal, but should leave space for new bone tissue from the marrow-cells to form around the plug. In some cases this will be all that is necessary, although if there is any tendency to misplacement of the fragments, it will be well to use a silver splint on the outside of the shaft.

In case the periosteum is badly stripped from one fragment, it is advisable to swing a flap of the periosteum from the other fragment across the fracture to the opposite fragment, leaving a good pedicle for the circulation of the flap. This not only tends to steady the fragments, but also adds materially in the development of the periosteal callus.

We prefer to keep the fracture in a splint dressing for two weeks and then remove the stitches and put up in plaster. We must bear in mind that in the old cases the formation of new bone will be slow and a hard callus may not form for several months. We have never had to remove a plug and do not consider it necessary to do so unless it gives trouble. In one of our cases the plug was discharged through a sinus several weeks after the operation.

CASE 1.—Male, forty-eight years of age. Family history negative. Always well; no history or evidence of constitutional trouble. In September, 1905, he sustained a simple fracture of the right humerus while blasting in a mine in Montana. The fracture was treated in the usual way, but it did not unite. In March and in June of 1906, and again in January, 1907, it was treated by open operation, but when he came to us in September, 1907, there was no evidence of union, and he had not felt, at any time, that the bones were united. The skin wounds

were entirely healed. The fracture was at the juncture of the middle and upper thirds of the humerus. *x*-Ray showed no evidence of callus formation, but showed a good-sized piece of wire which had been broken. The ends of the fragments were in fairly good apposition. We tried the Bier hyperemic treatment for several weeks, and at three different times blood which was drawn from the superficial veins was injected into the area between the fragments. This made no apparent change. We operated in November, 1907. First the broken wire was removed and the ends of the fragments freshened; then a small ivory plug was placed so that it projected into the marrow cavity of each fragment about 1 inch. The plug was held in place by a linen thread carried through the wound to the dressing. The arm was put up in a splint dressing for two weeks and then changed to plaster-of-Paris. Six weeks from the time of operation there was but little evidence of union, but in three months there was a fairly good callus, and in six months the bone was apparently solid. In this case the wound healed with the ivory plug in place.

CASE 2.—Male, forty-seven years of age. Has chronic Bright's disease. September, 1907, he fractured both bones of the left leg in middle third. Simple fracture. Nine weeks after the injury the leg was broken over and wired. He came to us for treatment in January, 1908. There was no evidence of union. *x*-Ray showed fracture in middle third of tibia and fibula. Fragments in good apposition. One week before coming to us a piece of dead bone had been discharged. The sinus healed slowly and with no evidence of union. In June, we freshened the broken ends and set a piece of ivory in the canal. Six weeks later the plug came out through a sinus, and at this time there was very little union, but there was evidence of developing callus. In four months there was a large callus and fair union.

CASE 3.—Male, twenty-eight, fireman, healthy. July, 1907, sustained simple fracture of both tibiæ and both fibulæ. Fractures were in the middle third of both legs. Each leg had been operated upon twice. *x*-Ray showed a fairly good callus in the left tibia and there was slight union at this time. There was no callus and no evidence of union in right tibia. In this case we resected the fibula, as it was too long, and did the usual operation on the tibia. As in the other cases, there was no apparent union for several weeks, but in four months he was able to walk with the aid of a cane.

CASE 4.—Male, laborer, age thirty-eight. One year ago sus-

tained simple fracture in the right humerus, middle third. In this case the *x*-ray showed considerable displacement of fragments and no callus. He had been operated upon once, though there was very little scar tissue. In September we operated, and in addition to the usual operation we used the silver splint fastened by screws to either fragment, because of the marked tendency to displacement. The wound healed with the ivory plug and silver plate in place, and in three months all dressings were removed and the patient was able to begin light work.

It is possible that we lay too much stress on the use of the ivory plug, and that results just as good can be obtained in other ways. But we feel sure that the plug acts as a stimulus to the formation of callus, and for this reason it is an aid in all cases of ununited fractures, and especially in those fractures in which primarily very little or no callus has developed.

THE SURGICAL TREATMENT OF BUNION*

By CHARLES H. MAYO

The discomfort suffered by patients afflicted with bunions is so far in excess of the apparent simplicity of the malady that the disease has come to be a subject well worthy of consideration from a surgical point of view. The condition is usually associated with hallux valgus, and is attributed to various causes, the principal one being the wearing of pointed, short, and tight shoes. Arthritis and gout may be contributing factors in some cases. From the examination of many patients with this trouble it appears that the peculiar shape of some feet renders them liable to this deformity. The primitive foot was probably used for grasping objects, the great toe being situated farther back, somewhat like, but less marked than, the thumb on the hand, and as is now seen in some of the lower animals.

Confinement of the foot incident to civilization has possibly tended to the advanced position of the great toe, though many feet still present the short great toe with the wide foot in which the second and often the middle toe is the longer. Such feet rarely have the deformity "hallux valgus," although some slight bunion may be present, and this regardless of the kind of shoe worn.

The characteristic of the foot with tendency to bunion is that the great toe when straight is from $\frac{1}{4}$ to $\frac{1}{2}$ inch longer than the second toe. This type of foot may remain a perfect foot through life, but should it become confined in a pointed-toe, narrow, and especially a short shoe, the leverage action against the inner side of the great toe develops hallux valgus, with true bony growth on the inner side of the head of the metatarsal bone which becomes covered by a bursal layer. This area becomes most painful to

* Reprinted from "Annals of Surgery," August, 1908.

pressure and is liable to special attacks of inflammation. The tendon of the extensor proprius pollicis becomes displaced to the outer side of the joint area, and with the angulation of the toe its sheath becomes a pulley which soon gives way to tension, after which the tendon acts to still further increase the deformity.



Fig. 221.—Hallux valgus deformity as shown by photograph.

Many patients have the trouble in so slight a degree that proper shoe-fitting will relieve them. Some secure comfort by wearing special appliances for supporting the toe or protecting the bunion.

Several operations are recommended for the cure of hallux valgus. Resection of the metatarsophalangeal joint is often

practised; also a wedge-shaped or simple osteotomy of the metatarsal bone, which will relieve some cases, but does not narrow the foot or remove the bunion, if it is present.



Fig. 222.—Deformity as shown by radiograph.

It is also recommended by some operators to remove the head of the metatarsal, and, to avoid the scar about the inner side of

the joint, their incision is made between the first and second toes.

For a number of years we have practised the following method

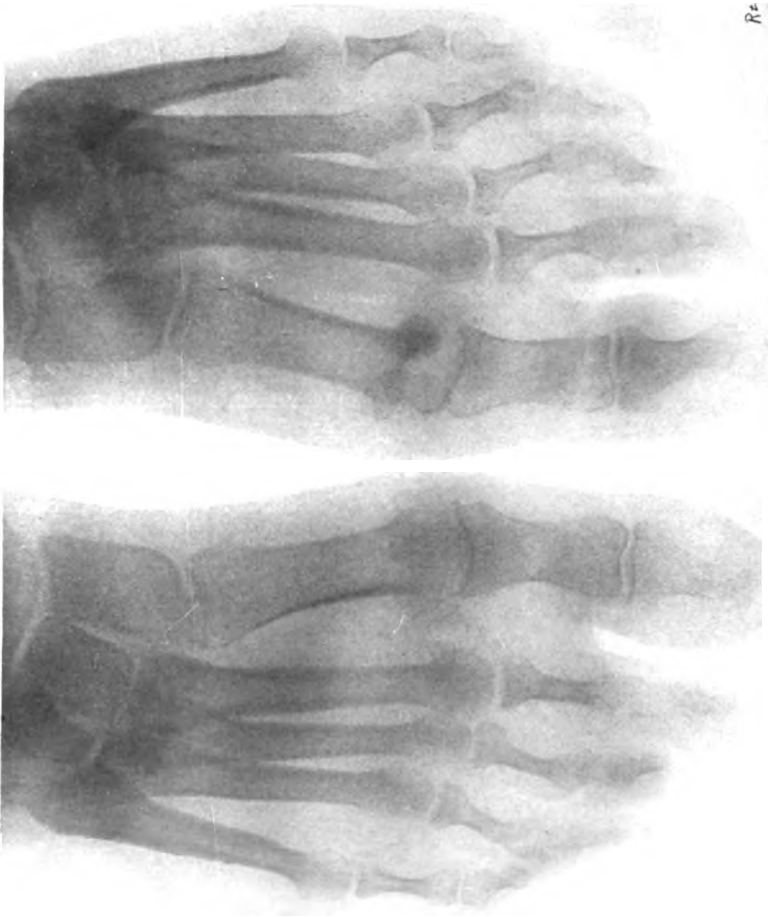


Fig. 223.—Radiograph of result after nine months.

in operating upon patients afflicted with this trouble, and the regularity of its success leads us to present the technic of the method.

Operation.—A curved incision is made base down over the

inner side of the metatarsophalangeal joint, the skin being lifted in the flap which is separated from the bursa. A curved incision "horseshoe" is now made around the bursa with its base forward left attached to the base of the first phalanx, its inner surface being synovial membrane and continuous with the anterior surface of the joint.

The head of the metatarsal bone is then removed with heavy forceps, the section also removing two-thirds of the anterior portion of the bony hypertrophy on the inner side. The remainder

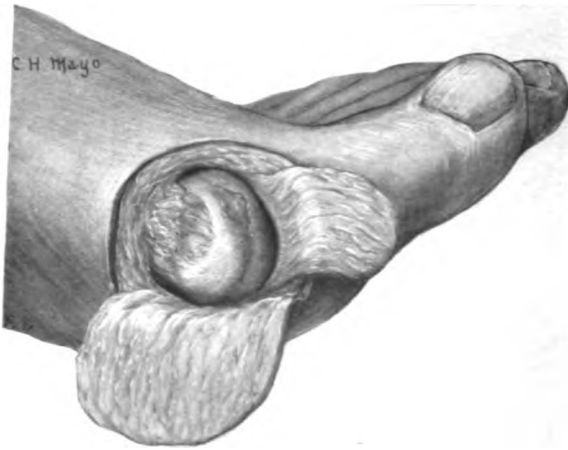


Fig. 224.—Showing bony deformity.

of this projecting bone is cut away to the level of the shaft of the metatarsal. The cut end of the metatarsal bone is now rendered as smooth as possible by rongeur forceps and the bursal flap turned in to the joint area in front of the bone, where it is held in place by one or two catgut sutures. We thus utilize an already formed bursa to secure and maintain a movable joint which works in a movable splint,—the shoe,—and thereby secure an immediate result, which is obtained with difficulty in other joints by transplanting fatty tissue into the joint area to prevent bony union—an operation made familiar by the efforts of Dr. J. B. Murphy,

who has demonstrated its great value in certain cases where the joints have become fixed by injury, disease, or operation. But in these cases, there being no natural fixed support like the shoe, it is necessary to use apparatus to limit and direct the motion. In some cases the tendon and sheath of the extensor proprius pollicis is best displaced by suture to the inner side of the mid-line of the toe.

Provision is made for drainage by a punctured incision in the base of the skin-flap, in which is inserted a doubled catgut strand.



Fig. 225.—Bone section ready for insertion of bursa.

The skin incision is now sutured in place with horsehair or catgut. The dressing is a pad of gauze wet in 70 per cent. alcohol, placed between the great and second toes. The anterior portion of the foot is covered with a dressing which is moistened with the same solution at intervals during the first few days.

With ordinary care in protecting the wound these patients are often much better able to go about within two weeks than they were before the operation. It frequently occurs that they are not even kept in the hospital during convalescence.

Motion becomes nearly perfect. The great toe is shortened to a reasonable degree, somewhat narrowing the foot at its widest line; a factor of importance in the prevention of recurrence. The bearing surface for support is excellent, as the under side of the

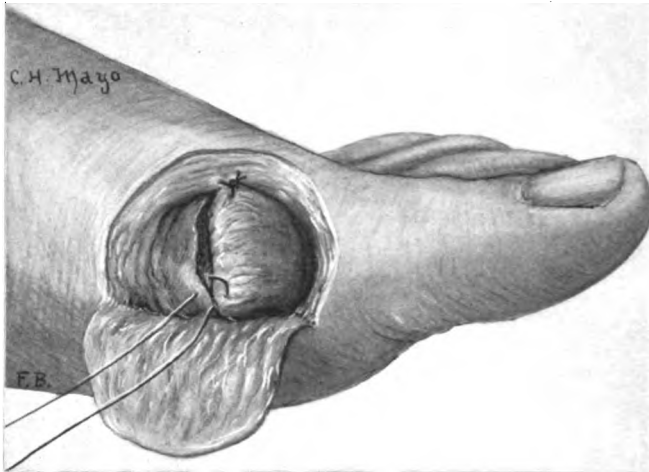


Fig. 226.—Suturing of bursa to develop joint.

joint floor is not disturbed, and the cushion beneath, with its sesamoid bones, is left intact.

Theoretically it could be said that the scar is badly placed and would be subject to pressure from the shoe. Practically this is not true, as we have found from operating upon sixty-five cases during the past eight years according to this method.

ANESTHETICS

A REVIEW OF OVER FOURTEEN THOUSAND SURGICAL ANESTHESIAS *

By ALICE MAGAW

— — —

Since the discovery of ether in 1846 by William Morton, much has been written about anesthetics and their administration, and still ether and better etherization is more in favor to-day than ever before.

We are indebted to Bevan and Mellish for their most excellent articles on this important subject, on the after-effects as well as the administration of anesthetics.

At St. Mary's Hospital our preference has always been ether. In 1905, out of 3080 anesthetics 2847 were ether. In 14,380 anesthetics given by me, I have yet to see a death directly from the anesthetic, but, no doubt, have had my share of trouble in its administration, although artificial respiration with us is almost unheard of. Our experience with ether has become more gratifying each year. In my series of cases the "open method" has been the method of choice. We have tried almost all methods advocated that seemed at all reasonable, such as nitrous oxid gas as a preliminary to ether (this method was used in 1000 cases), a mixture of scopolamin and morphin as a preliminary to ether in 73 cases, also chloroform and ether, and have found them to be very unsatisfactory, if not harmful, and have returned to ether "drop method" each time, which method we have used for over ten years.

On account of this method not being followed properly, it is not always appreciated. We use a 4-ounce ether-can and fit an ordinary cork with a groove on either side into its mouth, fill one groove with absorbent cotton, and let it extend out of the can about

* Reprinted from "Surgery, Gynecology, and Obstetrics," Dec., 1906, pages 795-799.

1 inch. One can regulate the drop easily by the manner in which the point is clipped. We usually fix two cans, one with a large dropper, and use it until the patient is fully under the anesthetic, and then change to the other can with the small dropper, and continue its use during the operation.

Patients usually walk into the operating-room and mount the table without assistance. All foreign bodies, such as artificial teeth, chewing gum, etc., are removed from the mouth. The hands are fastened loosely across the chest with a wide gauze bandage, to prevent the arms falling over the sharp edges of the table, an accident which so often causes musculospiral paralysis. A pad of moistened cotton is placed over the eyes to protect them from the anesthetic. If during the course of administration some of the anesthetic should fall into the eye, drop a few drops of castor-oil into the conjunctival sac, to prevent the conjunctivitis that would otherwise follow.

It is a mistake to think that the same elevation of the head will do for all patients. The anesthetist should elevate the chin to such a position as not to bend the neck too far back or approximate the jaw too near the sternum. Proper elevation of the head will relax all tissues of the neck and give more freedom in breathing. This, also, can be said of the jaw. Holding the jaw up and forward, and keeping it in position so that the patient gets the greatest amount of air possible, is an important feature in giving an anesthetic. While too much emphasis cannot be laid on this necessary requisite in giving an anesthetic, all jaws cannot be handled in the same manner. When a patient has removed a double set of artificial teeth, the tongue will often cleave to the roof of the mouth during the administration, and raising the jaw sets the gums so firmly together that most of the air is shut out, and this may not be noticed until the patient is cyanotic. We have found, in this class of cases, that if the jaw is held but slightly up and forward and the thumb of the same hand inserted between the gums, thereby holding the tongue down, faulty respiration will be corrected at once and the color restored. This is one of the instances where the holding up of the jaw too firmly can be overdone.

The inhaler used is the improved Esmarch, with two thicknesses of stockinet (frame boiled and stockinet changed after each patient). We use the dropper described, dropping as slowly and carefully in giving the ether as though it were chloroform, until the patient's face is flushed, and then a few layers of surgeon's gauze are added, and the ether given a trifle faster until the patient is surgically etherized; then return is made to the same covering as at the start, and the regular drop continued throughout the operation.

As it requires very little ether to keep a patient surgically etherized, one can change to the small dropper during the operation. A much deeper narcosis is required to start an operation or to make the incision than later on, when the operation is in progress. It is useless to touch the cornea, as so many advocate, as it tells us nothing and is unscientific. Only the inexperienced take the pulse and touch the conjunctiva when giving ether.

Suggestion is a great aid in producing a comfortable narcosis. The anesthetist must be able to inspire confidence in the patient, and a great deal depends on the manner of approach. One must be quick to notice the temperament, and decide which mode of suggestion will be the most effective in the particular case: the abrupt, crude, and very firm, or the reasonable, sensible, and natural. The latter mode is far the best in the majority of cases. The subconscious or secondary self is particularly susceptible to suggestive influence; therefore, during the administration, the anesthetist should make those suggestions that will be most pleasing to this particular subject. Patients should be prepared for each stage of the anesthesia with an explanation of just how the anesthetic is expected to affect him; "talk him to sleep," with the addition of as little ether as possible. We have one rule: patients are not allowed to talk, as by talking or counting patients are more apt to become noisy and boisterous. Never bid a patient to "breathe deep," for in so doing a feeling of suffocation is sure to follow, and the patient is also apt to struggle.

In gall-bladder work nearness to the diaphragm causes an irregular respiration, and this is sometimes mistaken for a call for more anesthetic, when more often it is just the reverse. If the

patient is surgically anesthetized, the irregular breathing and grunting do not interfere with the surgeon. Instead of drowning the patient with the anesthetic, remove the mask at this stage and allow him plenty of air, and he will not become cyanotic. This is also true of operations on the sphincter muscles. Any manipulation will be followed by the same symptoms. Respiration is often interfered with in this class of cases. Obstruction is caused by the tongue falling back and depressing the epiglottis. Should any of these symptoms arise during the administration, raise the jaw up and forward, and instead of using tongue-forceps, catch the tongue with a piece of gauze and draw it up and toward the nose, a little to one side, withdrawing the anesthetic. Should mucus become troublesome, one can easily wipe it out with an extra piece of gauze prepared for that purpose.

The dose required for each individual patient cannot be estimated so as to be of any value, as it depends largely on the temperament of the patient, pathologic condition present, time consumed in anesthetizing and operating. The only one that can judge is the educated anesthetist, who will give only what is needed to do good work. From experience we know a patient can be brought under ether in from three to five minutes, and, when ready, patients do better if the operation is started at once. Often the anesthetist is blamed for not having some positive sign of complete narcosis. We have never found a single positive sign upon which we could rely. If the surgeon and anesthetist are accustomed to each other, the surgeon seldom asks if the patient is ready. He knows from the deep respiration, color, and relaxation. Failures are in the acute peritonitis cases and in alcoholics. There are many signs that guide, such as deep respiration, relaxed jaw, as well as relaxed muscles; yet these signs sometimes fail. If the patient is kept in an even surgical anesthesia, there is not enough change in the patient to warrant all the useless fussiness we sometimes see on the part of the anesthetist. I rely a great deal on the relaxation of the jaw, both before and during operation. When the Trendelenburg position is necessary, it means trouble for the surgeon, and simply delays all work, to start the operation before complete relaxation.

During the operation, as soon as the patient begins to get control of the jaw, more complete narcosis is required. If the jaw is relaxed and in place, respiration deep and regular, color normal, quality of pulse good, there need be no fear about the rate of pulse or the pupils. Other points being equal, they are certain to be right.

As a rule, any person fit for a serious operation is also fit for an anesthetic, but no one is so free from danger that care in watching its effects can be dispensed with. The cases requiring the greatest care are not the young and anemic, for whom a small dose is sufficient, but the strong and vigorous, who inhale deeply and are inclined to struggle.

There is no class of cases that requires more close watching of every detail than the stomach cases, because they are poor subjects for anesthesia of any kind, and the anesthetist should be familiar with each step of the operation, so as not to give one drop more of the anesthetic than is absolutely necessary. We give $\frac{1}{4}$ of a grain of morphin thirty minutes before the administration of ether, and the patient is given just enough ether to produce surgical anesthesia, and as soon as the stomach is explored and the method of operation decided upon, the ether is withdrawn, the surgeon being able to continue operation, no more being given until time to close the incision.

In this class of cases the patients are allowed to become almost conscious many times, as the stomach is not sensitive, and there is no pain in the visceral work; thus we are able to complete the operation with an exceedingly small amount of anesthetic and avoid vomiting.

The rolling of the eyeballs as noted by Simpson, swallowing, and control of the jaw are signs of returning consciousness, and a call for more ether. While we give less anesthetic in this class of cases than in any other, it is this class that is most prone to pneumonia.

During the thirteen years' work at St. Mary's Hospital all patients have been anesthetized on the operating table in the operating room, and preparation of the patient was going on at the

same time. Experience has taught us that preparation of the patient while going under the anesthetic is one of the important factors in producing a rapid surgical narcosis; for it diverts his attention, and much less anesthetic is required. It matters not in what position the patient must be for operation, we fix him accordingly, and the preparation is begun at the same time as the anesthetic, and we feel certain that this procedure enables us to hasten narcosis.

In the Trendelenburg position, where the preparation is in progress during the administration of the anesthetic, the deep respiration, etc., empties the pelvis, so that by the time the operation is started the small bowel will be found in the lower abdomen and out of the way, and may be packed off. We have found this practice more helpful to the surgeon than placing the patient in position after the completion of narcosis.

In giving an anesthetic for this class of surgery, the skill and patience of the anesthetist are tried to the extreme; the patient must be fully anesthetized, but not too profoundly. Patients having an acute peritonitis, as is so often found in this class of cases, require a much larger amount of anesthetic to produce relaxation of the abdominal muscles. When the patient is prepared during the administration of each anesthetic, there is no time lost, the surgeon and his assistant being ready by the time the patient is surgically anesthetized. Another important reason for anesthetizing the patient on the operating table is that, in lifting and shifting a patient about, he is apt to regain consciousness, with vomiting, etc., and the administrator is not positive of the condition of his patient. Should ether produce difficult breathing, profuse secretion of mucus, or cough, lift the mask from the face, allow a liberal amount of air, and then continue with the ether. In giving plenty of air when needed, and less anesthetic, we have found little use for an oxygen-tank, a loaded hypodermic syringe, or tongue-forceps. It is far better for the anesthetist to become skilful in watching for symptoms and preventing them, than to become so proficient in the use of the three articles mentioned. We are exceedingly careful in our selection of cases with colds. An acute

cold is a contraindication to any anesthetic, but as soon as the cold becomes chronic there is not much danger from etherization, and instead of operating during an acute cold and giving chloroform (unless in an emergency), we wait a few days until the acute attack has passed, and then they are as good subjects for ether as for any other anesthetic. Chronic bronchitis is often improved by an anesthetic.

Pulmonary tubercular cases stand ether well. It has been proved that pneumonias follow a local anesthesia as well as a general, so the trouble is not wholly from the anesthetic. We often have a lung edema present during the administration of an anesthetic, and for several hours after an operation, that is often mistaken for ether pneumonia, but the edema will clear up about the time an ether pneumonia should begin.

There is also an embolic and septic pneumonia that occurs independently of the anesthetic and is due to an infection, and will sometimes occur with or without a general anesthetic.

The dangers of general anesthesia depend more on the lack of experience and incompetency of the anesthetist than on the drug itself, in most instances. Many operations do not demand the long anesthesia of ether, with its discomforts, neither do they warrant the dangers of chloroform anesthesia. In this class of operations we have been using primary anesthesia, and find it preferable to nitrous oxid gas, chloroform, or ethyl bromid.

Formerly, operations for exophthalmic goiter were looked upon with a great deal of dread, on account of the anesthetic. We have found that these cases, when properly managed, and the ether given by the "drop method," were as good subjects for anesthesia as any other class of cases of the same gravity. We also give these cases $\frac{1}{6}$ of a grain of morphin and $\frac{1}{120}$ of a grain of atropin, the latter to avoid tracheal mucus, thirty minutes before operation, and find it very helpful in tiding the patient along with but a small amount of anesthetic.

The method of giving chloroform is quite like that of ether; yet there are marked differences to observe. Chloroform should be given with more air and in less quantity, with the regular and

small drop. Chloroform acts quickly, and should be given slowly and carefully, the pulse being taken at the facial or temporal arteries. Anesthetists should never allow either the patient or themselves to feel hurried. Stop inhalation as soon as patient has reached surgical anesthesia, giving just what is needed, and not one drop more. When struggling occurs, withdraw the chloroform entirely until the patient is quiet, as struggling will produce deep inhalation; hence the danger. Embarrassment in respiration during the administration of chloroform should always be considered serious, and it requires prompt attention and an immediate withdrawal of the drug.

The pulse often misleads the novice. It may be very weak just before vomiting, when one might think there was less need of anesthetic, while really it is a call for more. A thready, intermittent pulse indicates trouble. As Dr. Finney says: "It is well to watch the character and rate of pulse, but of far more importance to watch the respiration as the earliest indication of danger." The eyes may give warning of danger. A rapidly dilating and fixed pupil is a danger-signal, while a pupil contracted to a normal size or a little less indicates surgical anesthesia. The color of the blood is also important. Watch all symptoms, but do not rely on any one of them. When giving chloroform to children, I never feel safe if the child is profoundly under, and I try to avoid this condition, aiming to keep it as nearly as possible in moderate anesthesia. An unsatisfactory pulse or respiration is a call for plenty of air. By doing this there will be little need of the numerous drugs so often resorted to.

Nearly all fatalities on the operating table due to an anesthetic are from chloroform, either mixed with some other anesthetic or given unadulterated. Public opinion is so much in favor of ether at the present day that if accidents in its use occur, the surgeon will not be blamed, and it is to his interest, as well as to that of his patient, to see to it that his anesthetist becomes proficient in the administration of all anesthetics, especially ether.

While surgeons know that a competent anesthetist is one of the important factors in the operating room for his own comfort, as

well as for that of his patient, there is no class of work that has so little encouragement, and few are willing to follow this line of work (that, in difficulty and nerve-strain, is next to that of a surgeon) long enough to become familiar with the first requirements of a good anesthetizer.

To give an anesthetic properly is all one person can do, and he who undertakes to learn surgery at the same time makes a serious mistake. It has been my privilege to instruct several in the administration of anesthetics, and I must say that nurses become the most proficient in this line of work. They do not aspire to be either a surgeon or an assistant surgeon; hence it is not difficult for them to give their undivided attention to the anesthetic. I am sure the time is not far distant when nurses will be looked upon as best fitted for the administration of anesthetics.

One derives little or no benefit from text-books. While one should be competent in the theoretic part of this important work, there is nothing so helpful to the anesthetist as the hard school of practical experience.

TECHNIC

A METHOD FOR THE RAPID PREPARATION OF FRESH TISSUES FOR THE MICROSCOPE*

By LOUIS B. WILSON

While engaged in general pathologic work I shared the common distrust of frozen sections of fresh tissues for microscopic diagnosis. On taking charge recently of the laboratories of the Drs. Mayo, surgeons, I carefully tested the various methods hitherto published, and found them either too slow for results while the patient waits under the anesthetic or else giving poorly differentiated cell detail. After considerable experimentation the following technic was discovered, and for the last six months it has given uniformly excellent preparations:

1. Bits of fresh tissue not more than 2 x 10 x 10 mm. are frozen in dextrin solution and cut in sections of from 10 to 15 microns thick.

2. The sections are removed from the knife with the tip of the finger and allowed to thaw thereon.

3. The sections are unrolled with camel's-hair brushes in 1 per cent. NaCl solution.

4. The sections are stained from ten to twenty seconds in neutral Unna's polychrome methylene-blue.

5. They are washed out in 1 per cent. NaCl solution.

6. They are mounted in Bruns' glucose medium.

The microtome which I use is the Spencer automatic, with a CO₂ attachment, in which vulcanite is substituted for brass in the wall of the freezing chamber, thus insulating the freezing plate. Thawing the section on the finger prevents to a great extent the formation of bubbles. The well-made camel's-hair brushes used

* Reprinted from "The Journal of the American Medical Association," December 2, 1905.

by artists are much more useful for handling tissues than those usually furnished by laboratory supply houses. A heavy, shallow watch-glass over a black surface is the best receptacle in which to unroll sections. Sections are best handled in the stain folded over a lifter made of a small glass rod drawn out and bent at convenient angle. The section is kept constantly moving while it is in the stain. The stain is contained in a minute cup to facilitate the rapid recovery of the section should it slip from the lifter. Washing out is done in several ounces of salt solution in a white porcelain dish and is continued only while the stain comes away freely. Bruns' glucose medium (which is made by mixing distilled water 140 c.c., glucose 40 c.c., and glycerin 10 c.c., then adding camphorated spirit 10 c.c. and filtering) is held in an oval dish of porcelain (an "undecorated match-safe") of such a size that a 3-inch slide will rest in a slanting position, with one end in the bottom of the dish and the other on its edge. The section is spread out on the slide while it is in this position. The slide is then carefully withdrawn from the dish, the excess fluid removed, a cover-slip dropped over the section, and the specimen is ready for the microscope.

The whole process can be gone through in one and a half minutes from the time the tissue is placed on the freezing plate of the microtome until the stained specimen is on the stage of the microscope. The resulting coloring is uniformly good, with the tissue elements sharply contrasted in red, purple, and dark blue.

A diagnosis may be made from such preparations in a large percentage of surgical cases in which a diagnosis is possible by a study of sections of the same thickness cut from fixed tissues and stained with hematoxylin and eosin.

OPERATING-ROOM TECHNIC *

By E. H. BECKMAN

Hospital methods and operating technic are constantly changing. There are many institutions that have perfected methods giving splendid satisfaction for themselves that may be entirely unsuited for some other hospital doing a different class of work, managed differently, or situated in different surroundings.

Each institution must, to a certain extent, develop methods suited to its particular requirements, yet may gain much by studying the methods developed by other hospitals doing similar work.

The methods employed at St. Mary's Hospital do not differ greatly from those in use in other places. They are not given here as a standard for other hospitals, but are simply those which have been found satisfactory for a hospital in a small city doing a large amount of surgical work. They are more simple than those generally employed. Simplicity means economy—economy in material, in the number of employees, and in time.

Economy, however rigidly it is practised in other departments of the hospital, is often conspicuously absent in the operating room. The hospital authorities are not to blame for this wastefulness, for the surgeon is often wanton in his extravagance. It is not unusual to listen to a talk on this subject, by the surgeon, while he is at the same time using to ligate a single small vessel 15 inches of the most expensive catgut that can be bought.

Good technic is not measured by the number of assistants and nurses in the operating room, any more than is asepsis measured by the size of the pile of soiled linen. If every hospital would keep

* Reprinted from "The Old Dominion Journal of Medicine and Surgery," vol. ix, No. 3, Sept., 1909.

a strict account of the amount of material used, the amount of linen soiled, and the amount of time of all assistants, anesthetists, nurses, and orderlies supplied each surgeon working at the hospital covering a period of six months, the results in most instances would be startling to the surgeon and hospital authorities.

At St. Mary's Hospital, during the year 1908, more than 6400 operations were performed, and more than half of the year only two operating rooms were in use. The regular operating room force consists of the operator, a first and second assistant, a nurse, and an anesthetist. With this force it is not unusual to operate upon ten or a dozen patients between 8 A. M. and 1 P. M. in one operating room.

The economy at this hospital is due to many factors, some of which are not possible in other hospitals. The chief factors contributing to simplicity and economy are as follows:

The central thought about the institution is to get the patient well with as little loss of time as possible, and everything that cannot be shown to contribute to this end is eliminated.

The hospital is not a teaching institution, and therefore it is not necessary to be constantly educating people in the elements of surgical work.

The operating room force is the same the year around, which lessens delay and prevents waste.

The patients are brought to the operating room, placed upon the operating table, and there anesthetized and prepared for operation at the same time, which saves from ten to twenty minutes on each operation when compared with methods practised in most hospitals.

There seems to be a prevalent idea that the patient should not be permitted to see the operating room at the time of his operation, although the great majority of patients express a desire to see it, and are allowed to do so at some time during their stay in the hospital. The modern operating room is attractive and clean, and it cannot do any harm to let the patient see this for himself. It is certainly more reasonable to let your patient see a clean, well-appointed operating room, than to surround it with such an air of

mystery that he is led to believe it is such a horrible sight that he cannot be taken there until he is asleep.

A small table which holds the instruments for each operation swings over the knees of the patient and allows the operator and his assistant to pick up the ones needed, thus doing away with the necessity of having some one to hand instruments.

Anesthetics are given by nurses who make this their chief business, thus saving much time.

Anesthetics.—Ether is given exclusively as the anesthetic of choice. Chloroform is rarely used. In 1908, out of a total of 5201 anesthetics, there were no straight chloroform anesthetics. Chloroform is used principally to continue the anesthetic in the class of cases where work is done about the nose and mouth, and it is impossible to keep the face of the patient covered enough to administer ether; such as cleft palate and hair-lip cases. In this class of cases, however, the patient is first put to sleep with ether.

The ether is administered by the drop method on a chloroform mask covered with stockinet. As the patient begins to feel the effects of the ether, and the anesthetist desires to obtain a more concentrated vapor, surgeons' gauze is folded over the stockinet to any thickness desired, and the ether dropped upon this gauze.

To prevent infection being conveyed from the mouth and air-passages of one patient to the patient following, the hands of the anesthetist are washed between operations, the mask sterilized, a fresh sterile piece of stockinet is placed upon it, and another fresh sterile piece of gauze is used for folding over the mask. At the end of a day's work *these pieces of stockinet and gauze are washed, sterilized and used again.*

Preparation of Patients for Operation.—At 3 p. m. the day before operation, patients are given 2 ounces of castor oil. (All operations are performed in the forenoon.) The patient is given a light supper, three hours later a bath. No poultice, pad, or antiseptic is applied to the field of operation during the night. If satisfactory results have not been obtained from the laxative by the following morning, an enema of soap and water is given. No breakfast is allowed

on the morning of operation, and the field of operation is shaved before entering the operating room.

The soap used for scrubbing up patients in the operating room is a hard soap, such as mechanics use for removing grease. It is strongly alkaline, containing pumice, and makes a generous lather in hard water. It removes grease and loosened epithelium, leaving the skin clean and smooth. One of its best assets is its cheapness. It is called "Jumbo" soap by the manufacturers. Graham Bros. & Co. of Chicago are the makers.

Patients requiring operations upon the stomach have the stomach washed clean with the stomach-tube and warm water before going to the operating room, and they receive a hypodermic of morphin, gr. $\frac{1}{8}$, a half hour before operation.

Patients to be operated upon for goiter or other neck operations have a hypodermic injection of morphin, gr. $\frac{1}{8}$, and atropin, gr. $\frac{1}{120}$, a half an hour before operation, to prevent mucus forming in the throat and to prevent coughing which may result from irritation to and traction upon the parts adjacent to the air-passages.

When the patient comes to the operating room and lies down on the operating table, a heavy blanket is folded over the legs and extends half-way up the thighs. A wide web strap (a surcingle) is buckled about the table and over the thighs of the patient just above the knees. This prevents the patient from drawing up the knees. The patient's hands are clasped together over the chest (not the ordinary folding of the arms) and tied with gauze attached to the head of the table. The tying is done in such a way that the hands cannot be moved toward the feet, but can be moved slightly from side to side and toward the head.

The preparation of the field of operation consists in scrubbing with Jumbo soap and gauze (no brushes are used upon the skin). After the skin is thoroughly cleaned with soap and water, Harrington's solution is applied (mercuric chlorid, 0.8; hydrochloric acid, c. p., 60; alcohol, 700; water, 240) for about thirty seconds, followed by 70 per cent. alcohol. If the skin is rough and irritated, tincture of iodine is applied after the above preparation and left on as a final step.

Preparation of Operator and Assistants.—The hands and arms are scrubbed in running water with gauze and Jumbo soap. No brush is ordinarily used. If one is used, it is only about the nails. The nails are carefully cleaned with a nail file, and the hands again scrubbed. Harrington's solution is used about the nails only, and then the hands are washed in 70 per cent. alcohol.

The head is covered with a linen skull-cap or a piece of gauze and a face piece is tied about the mouth of the operator and first assistant before the hands are washed.

The gowns are made with short sleeves reaching half-way to the elbow. Long sleeves are drawn on and pinned with a safety-pin, and a sterile towel is pinned over the front of the gown before each operation. The gowns are not changed unless they become soiled or unless the case has been an infected one.

Sterilization of Instruments and Gloves.—All instruments except knives are sterilized by boiling in water alkalized with soda. All basins used for scrubbing up patients, pans, trays, glasses, and the various utensils used in the operating room are sterilized by boiling. Knives are sterilized by being kept in a 10 per cent. lysol solution. Gloves are sterilized by boiling in water. They are then placed in a 1:5000 bichlorid of mercury solution and put on while in this solution.

Dressings and Packs.—All dressings, gowns, towels, pads, etc., are sterilized in the ordinary high-pressure steam sterilizer at 15 pounds pressure.

Sponges for keeping the field of operation dry are made of gauze and folded so as to have no cut edges exposed, which might leave threads in the wound. When folded they are $2\frac{1}{2}$ inches square.

For packing off in the abdomen, three sizes of packs are used: (1) sponges 4 x 8 inches made of eight thicknesses of gauze; (2) packs to displace viscera, which are 5 inches wide and 3 yards long, made of eight thicknesses of gauze; and (3) packs 3 inches wide by 2 feet long, for packing off about the gall-bladder. These packs all have hemmed edges and a tape 6 inches long sewed to one corner for anchoring.

All clean non-drainage wounds, such as clean appendix cases,

hernias, and laparotomy wounds, are dressed by placing next to the wound two or three thicknesses of gauze wrung out of a solution of 1:500 tincture of iodine in water. This is covered with a dry pad of gauze four to six thicknesses, and held in place with adhesive straps. No cotton or binders are ever used except in drainage cases. In drainage cases the gauze is wrung out of salt solution, absorbent cotton placed next to the gauze to take up moisture, and common sterilized cotton outside to distribute the moisture and prevent it soaking through into the clothing; the whole is then held in place with a binder.

Suture Materials.—No silk is used in this clinic. Instead of silk, a hard-twisted iron-black Irish linen is used. It is sterilized by boiling. Three sizes are used—25, 35, and 50.

Silkworm-gut is sterilized by boiling eight minutes and then stored in a solution consisting of one part iodine crystals in 60 per cent. ethyl-alcohol.

Horsehair is washed at intervals for several days in soap and water, soaked for twenty-four hours in 1:1000 bichloride, then boiled for three minutes (longer boiling makes it brittle), and kept stored in the same solution as silkworm-gut.

Catgut in sizes Nos. 1, 2, and 4 is bought raw and prepared by the method of Dr. Willard Bartlett as follows: The gut is cut into desired lengths and made into coils, which are strung on a thread so that they can be conveniently handled. They are then placed upon asbestos in a hot-air chamber and the temperature gradually raised during an hour to 180° F., during the next half hour it is raised to 220° F., where it is kept for thirty minutes. The gut is now transferred to an asbestos-lined kettle and placed in liquid albolene until it is clear in the sense that microscopic sections are clear. This requires several hours, usually twelve. The usual practice at St. Mary's Hospital is to leave it in the albolene overnight and finish the sterilization the following day. The kettle is then placed upon a sand-bath, and by gradually raising the temperature through a period of one and one-half hours the maximum temperature of 320° F. is reached, at which point it is kept for an hour. Brittleness results from raising the temperature

too rapidly and by exceeding the maximum temperatures. The gut is finally stored in a solution of one part iodine crystals in 100 parts of Columbian spirits. To get rid of the excess of oil the gut is either allowed to drip or is rinsed in the storing solution. The gut is heated far in excess of anything else used in the operating room and consequently is sterile. If it is carefully and properly prepared, it is soft, pliable, and very strong.

Drainage-tubes.—Straight and curved glass tubes of different sizes are used in the pelvis in cases of diffuse peritonitis or in a large abscess cavity. A strip of selvedge-edged tape runs through the tube and a large moist dressing covers and surrounds the projecting ends of the tube. The dressing is kept moist with sterile water or normal saline solution to promote capillary drainage. These tubes are removed in from twenty-four to forty-eight hours and replaced by a split rubber tube if there is much drainage.

Rubber tubing with a longitudinal split inclosing a strip of selvedge-edged tape is used in the abdomen for draining abscess cavities or any place where much discharge is expected. The tape is removed the second or third day, and beginning the third day the tube is gradually shortened until it is finally removed, often on the fifth day and always by the end of a week.

In small cavities or places where a slight amount of infection may take place in the abdomen, a cigarette drain or one or two small drains made by rolling up a sheet of gutta-percha tissue are used.

Gauze in any quantity is never used as a drain in the abdomen, but a small amount is used sometimes to control hemorrhage by being packed against an oozing surface. This is removed as soon as it has served its purpose of aiding clotting.

In draining cavities outside of the abdomen, such as result after radical breast operations, removal of glands in the neck, or goiters, a rubber tube, cut spirally by revolving it on its long axis while cutting, is used with a piece of selvedge-edged tape in the lumen. The tape is removed in twenty-four hours, and the tube the second or third day.

For draining the gall-bladder following the operation of cholecystotomy a drain made in the following way is employed:

A rubber tube with a lumen of $\frac{1}{8}$ inch is wrapped for about 6 inches back and forth with three or four layers of selvage-edged tape and then covered with gutta-percha tissue. This tube is inserted into the gall-bladder and the cut edges of the gall-bladder are inverted against the gutta-percha and held inverted with a double purse-string suture of No. 1 catgut. After tying the purse-string suture and before cutting the ends off, one stitch is taken through the tube and another knot tied. This last stitch prevents the tube from being easily pulled out of the gall-bladder until the catgut has been absorbed.

The tape wrapped about the tube furnishes a body to tie the purse-string suture against tightly, and at the same time prevents the rubber tube from being collapsed by pressure, while the gutta-percha tissue prevents granulation forming into the meshes of the tape, thus insuring the drain being easily removed when desired.

If the gall-bladder easily reaches up to the parietal peritoneum, it is sometimes sutured there with one or two sutures. If any tension is required to bring the gall-bladder to the parietal peritoneum, it is never sutured, as it is considered of no great importance whether the gall-bladder reaches the peritoneum or not.

If the walls of the gall-bladder are thick so that they do not invert well, or there is a severe infection in the gall-bladder and consequently danger of peritonitis, a split rubber tube with tape inside is placed alongside of the gall-bladder in addition to the regular gall-bladder drain.

STEREO-PHOTOGRAPHY OF PATHOLOGIC SPECIMENS: SOME IMPROVEMENTS IN TECHNIC, AND NEW APPARATUS*

BY LOUIS B. WILSON AND HENRY G. ANDREWS

Two years ago one of us (W.) made a careful investigation of the methods of graphic representation of pathologic and similar specimens in use in the various schools and hospitals in this country. At that time it was found that while representation by drawings was in many places in a high stage of development, photography, particularly of gross specimens (pathologic, anatomic, botanic, geologic, etc.), had not kept pace with the best photography in commercial lines—*e. g.*, photography of jewelry, leather goods, machines, etc., for high-class illustrations in catalogs. The chief errors seemed to be in posing and lighting the objects. Thus it was found to be a common custom in photographing pathologic specimens, in order to get rid of the high lights, to immerse the specimens for some time in alcohol, and then to let them dry off in the air, or else to spray them with ammonium chlorid vapor which on evaporating left a thin coating of the salt. Both of these methods, while accomplishing the object of getting rid of the high lights, obscured detail in the tissue and gave a particularly dead and cast-like appearance to the specimens. It seemed necessary therefore at the outset, in attempts to improve the technic, that we not only should provide a specially rigid camera, good lenses, and controllable lighting, but also some form of posing tank in which the specimens could be completely immersed in water, under which fluid, it will be remembered, all minute dissections are best made and studied. After a number of experiments with different

* Received for publication Nov. 14, 1907. (Reprinted from "Journal of Medical Research," vol. xvii, No. 4, Jan., 1908.)

containers—glass dishes, porcelain bowls, pans, tubs, etc.—we finally adopted a wooden tank (see Fig. 227, T) with a plate-glass bottom, 16 by 24 inches inside, 6 inches deep, and supported on corner posts 15 inches high. The woodwork is painted a dead black. Light or dark backgrounds, as best suit the specimens, are placed on the floor underneath the tank. They are thus out of focus, and with properly placed light receive no shadow from the specimen. The tank is provided with a stop-cock for emptying, and is filled from a hose attached to a near-by faucet. It does not touch the camera nor any other article of furniture at any point, and, since the work is done in the basement with a rock bottom, it is practically free from vibration.

After trying daylight, incandescent light, arc light, and Nernst light, we settled down to the use of the Cooper Hewitt mercury-vapor light, and, all things considered, have found it far the most satisfactory. It is highly actinic, readily adjustable, properly diffuse, and, since it contains almost no red ray, renders unnecessary the use of screens for blood-containing specimens and orthochromatic plates.

Photographic lenses are to-day so generally excellent that one cannot go far astray in choosing those of any of the good makers. It should be remembered, however, that speed, the factor which has occupied the attention of the lens makers perhaps more than any other in the last decade, for this work may be wholly ignored. What is wanted is brilliancy and sharpness of detail with depth of focus. Other things being equal, it is, of course, true that with pictures approaching one diameter, long-focus lenses give better results than short-focus ones. Our present equipment consists of a 14-inch Bausch and Lomb-Zeiss "Tessar," a 14-inch Goerz "Celor" (more particularly for portraits), a pair of 6-inch Goerz "Dagor," and a 120-millimeter, a 90-millimeter, and a 60-millimeter Spencer "Heliar." The 14-inch "Tessar" is almost always used except where a magnified view of a small portion of the specimen is wanted.

Of the numerous good shutters, one that requires no setting and gives no vibration in its opening movements is desirable.

The camera for specimen photography must not only have long bellows capacity and be rigid in itself, but must also be supported by a very rigid stand, particularly when in the vertical position—that is, pointing down into the posing tank. Since neither the tank itself nor the specimens within it can be readily moved for centering without setting up disturbing waves in the water, it becomes necessary to provide for a free transverse motion of the camera in addition to the front-to-back motion into which the “rising and falling front” becomes converted when the camera is placed in the vertical position. In addition to these motions, in order to make stereoscopic pictures with a single lens, it is necessary to be able to swing the whole camera through a short arc on a center at the level of the focal plane of the object. Since the cameras on the market are all deficient in the above essentials, we have found it necessary to construct the piece of apparatus herewith shown (Figs. 227, 228).

The stand consists of a cast-iron horseshoe base (A) with three floor-bearing points, supporting a cast-iron forked pillar (B), through the upper ends of the arms of which is passed horizontally a heavy threaded shaft (C) supporting a cast-iron slotted table (D). Through the slot in the table is passed a cast-iron slide (E) which bears at its upper and lower extremities cast-iron brackets (F and G) for attaching the camera bed proper. The threaded shaft (C) when manipulated by the bevel gear (H) moves the table (D) and the attached camera transversely through a space of 4 inches. The table (D) is held securely in either the vertical or the horizontal position by a lever-locking device (I). The slide (E), with the attached camera, is raised and lowered (when the camera is in the vertical position) by a screw (J) running through a threaded block in the back of the table (D). Wear in the slide is taken up by an adjustable gib (K). The bracket (F) is attached to the upper end of the slide by a heavy bolt playing in a slot which is an arc of two and one-third degrees on the center of the bracket (G) at the lower end of the slide. The bracket (G) is attached to the lower end of the slide by a carefully ground and centered bolt. An indicator (N) shows the center of the specimen, and also when

the center bolt is on the level of the focal plane of the specimen. A lever (L) controls the swinging motion of the camera. It will thus be seen that the camera bed which is attached only to the two brackets (F and G) can be moved transversely, raised and lowered, and swung through an arc of two and one-third degrees on a center at its lower extremity. The whole stand is of extra heavy construction, weighing over 600 pounds, and when placed on solid rock foundation shows practically no vibration.

The camera bed consists of two heavy parallel rails bound together by heavy bolted ties. The structure is 12 inches wide and 7 feet long.

The camera, of 8 by 10 capacity, is made in three sections, each supported on solid frames held to the rails by extra large and heavy shoes which prevent the structure from sagging out of the horizontal when the bed is in the vertical position. A cone-extension (not shown in figure) on an adjustable front board permits the use of short-focus lenses to the depth of the posing tank. The total bellows capacity is 7 feet. By the use of the lower section only this may be reduced to 3 inches. For stereoscopic work a special back, designed by one of us (A.), provides for making the right-hand view on the left end of the plate, and the left-hand view on the right end of the plate, thus rendering unnecessary the usual cutting and transposing of negatives before printing. The "rising and falling front," giving front and back motion, is manipulated by a bevel gear (M) sliding on a long rod, which, by means of an adjustable milled sleeve, may be operated from any point.

This piece of apparatus has been built under our own supervision, and while some minor improvements may yet be made in it, it has great latitude and works very smoothly and accurately.

While any good single photograph of a properly posed and lighted specimen is a most valuable record of facts, it is only when a correctly made stereoscopic photograph of the specimen is viewed that a true appreciation and interpretation of the facts is obtained. After a long period of neglect—due partly to careless technic and partly to unsatisfactory methods of reproduction—stereoscopic photography of scientific objects, particularly in Europe, is recently

exciting renewed interest. In examining, however, even the best of the more recent stereoscopic photographs of anatomic and pathologic specimens, while their general excellence is good, one is forced to criticize first the cast-like appearance of the pictures, and second their grotesquely exaggerated relief.

The cast-like appearance is due, as we have shown above, to crude methods of getting rid of the high lights, but the absurd relief effect is produced by an error much more difficult to determine.

When we began a year ago to make stereoscopic pictures, we began with the ordinary method; that is, with a pair of good 6-inch lenses mounted in a stereoscopic shutter, we took, simultaneously, pairs of negatives. Our resulting pictures, while free of the usual cast-like appearance,—since our objects were immersed,—yet possessed quite as exaggerated relief as any of those of our predecessors. After a number of failures to overcome the difficulty with twin lenses, we decided to experiment with one lens, taking two pictures from different view points. For this purpose we constructed an experimental apparatus as follows (see Fig. 227): A 6-foot plank (P) was secured firmly in the vertical position to a weighted step-ladder (Q). To the lower end of the plank a second plank (R) 5 feet 10 inches long was attached by a single bolt on which it could freely revolve. A couple of L-screws at the upper end held it from dropping forward and two small brads served as indicators of the amount of lateral deviation. To the swinging plank were screwed two extended beds (S) to take an 8 by 10 view camera, which, with a posing tank (T), completed our apparatus.

With but one pose of a given object we then took several series of stereoscopic photographs of one-half, two-thirds, one, and two, diameters, using lenses of $3\frac{1}{2}$ -inch, 6-inch, and 14-inch focus, and separating the optical axes of the two views from one-half to ten degrees.

Without recording in detail all our degrees of failure and success, suffice to say here that we found that when the optical axes of the two views were separated by an angle of two and one-third degrees—i. e., $\frac{1}{2}$ inch separation for each foot of distance from the object—

the resulting relief effect in pictures viewed in the ordinary stereoscope, magnifying one and one-half diameters, was perfectly normal. This corresponds to the relief effect obtained by an observer whose interpupillary distance is $2\frac{1}{2}$ inches when viewing objects at 5 feet from his eyes. We also found that, so long as this angle was preserved, it made practically no difference in the relief effect whether the pictures were made with a $3\frac{1}{2}$ -inch, a 6-inch, or a 14-inch focus lens. A little calculation from the above data will also readily demonstrate the impossibility of making with twin lenses approximately one-diameter pictures showing correct relief. Thus, to make one-diameter photographs with 6-inch lenses, the lenses must be 1 foot from the object. If the resulting relief is to be correct, the lens centers must be only $\frac{1}{2}$ inch apart. But all 6-inch focus lenses are themselves, to say nothing of their mountings, considerably more than $\frac{1}{2}$ inch in diameter. Hence it is impossible to place them close enough together in any stereoscopic shutter to give correct relief in one-half or more diameters magnification. The ordinary stereoscopic shutter provides a distance of $3\frac{3}{4}$ inches between the lens centers. In order to obtain correct relief effects with lenses so mounted, it becomes necessary to pose a subject 6 feet 9 inches from the camera. We have been using this posing distance with twin lenses for portraits of goiter cases for several months, and get very satisfactory results. But, of course, pictures of specimens taken at the same distance would be valueless because of their small size.

We would suggest here also that a separation of two and one-third degrees between the viewpoints in making stereo-radiographs should give the same correctness of relief that it gives in ordinary stereo-photographs, and may very materially aid the surgeon in the localization of foreign bodies.

In passing, we may remark that the above-described piece of experimental apparatus, while it is inaccurate and inconvenient to handle and limited in its scope, yet it is the one with which we have made several hundred of our best photographs while our large apparatus was in process of construction. Any one possessed of a good view camera and a high-class anastigmatic lens can

readily construct for himself such a piece of apparatus which will give results in stereo-photography of pathologic specimens superior to any obtained with the apparatus commonly sold for the purpose.

One difficulty which has in the past stood in the way of the development of stereoscopic photography has been that of reproducing pictures. No simple means of obtaining relief effects from lantern-projected transparencies has yet been devised. The stereoscope remains to-day, as it was fifty years ago, the only practical means of viewing the photographs. When stereoscopic pictures are so viewed, the best of them which have been reproduced by the half-tone method show the half-tone lines in a very disturbing net-like effect in front of the picture. In the article by Drs. Mayo, Wilson, and Giffin on "Diverticulitis of the Sigmoid" (read before the American Surgical Association and first published in the July (1907) number of "Surgery, Gynecology, and Obstetrics"), we tried to overcome this difficulty by having the half-tones made with an extremely fine screen. The result was fairly good when viewed with the naked eye, but unsatisfactory when viewed through the stereoscope. We therefore furnished for the article as it reappeared (in the "Transactions of the American Surgical Association") photographs on a developing paper in place of the half-tones. They are almost as fine in detail as gold-toned prints and much more permanent. The only objection to them is the time and cost of their manufacture. We have, however, been able to make them on a "Velox printing machine" at the rate of six hundred per hour, which materially reduces the expense for labor.

But why take all this trouble to make stereoscopic photographs of specimens? Simply because each properly made stereoscopic photograph shows considerably more of the structural details of that particular view of the specimen than can possibly be seen by the unaided eye viewing the specimen itself in the air. As a mere record of the facts of the case its value is incalculable. Without in the least disparaging the great value of artists' drawings, it is nevertheless true that when a drawing of a pathologic specimen is made by an artist who is also a pathologist, it is of value as a record of fact only in so far as the artist-pathologist's judgment of

what is in the specimen is of value. But artists of keen pathologic



Fig. 227.

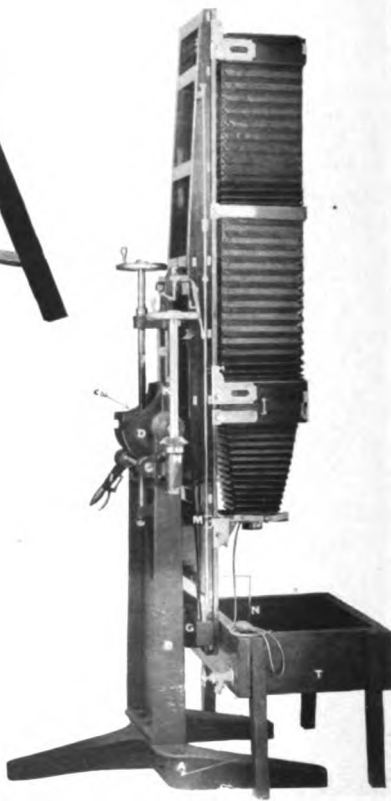


Fig. 228.

judgment are rare. Drawings more usually represent what the

artist thinks some pathologist thinks is in the specimen. The translated result is frequently a gross distortion of facts. It is to be feared that much of our average student's conceptions of gross pathology is obtained from such distortions. This may explain in large measure the frequent failure to recognize at the operation or autopsy-table the most obvious pathologic lesions.

The weakest point in all pathologic teaching to-day in our schools is in gross morbid anatomy, and this largely because of the inability to obtain enough fresh material at any one time for class observation. Good stereoscopic photographs of fresh material, with a stereoscope in the hands of each student, should very materially increase the effectiveness of this branch of pathologic teaching.

GENERAL PAPERS

PRESIDENT'S ADDRESS*

By CHARLES H. MAYO

Chairman of the Surgical Section of the International Congress on Tuberculosis,
Washington, D. C., 1908.

I am deeply conscious of the importance of my privilege in addressing an audience composed of those who are associated in the work of this great International Congress on Tuberculosis. In accepting the appointment as president of the Surgical Section, I not only assumed responsibility for the success of the Section, but I enlisted in a common cause with the professional men of all nations who are striving to suppress, or at least to alleviate, the suffering caused by this most dreadful of scourges, tuberculosis.

The general public still look upon the disease as one affecting the lungs, knowing but little of its varied manifestations. As men representing surgical methods in the treatment of disease, and dealing with localized tuberculosis, it devolves upon us to consider it from the preventive, preservative, and reconstructive standpoints.

Tuberculosis is a disease which affects the majority of civilized people at some time during their lives. As but 10 per cent. of the population die of it, we have a right to say that few serious diseases, not self-limited, tend more naturally to ultimate recovery than does tuberculosis. It is this tendency which renders it so much more favorable than malignant disease, and gives to those afflicted that greatest of all human blessings—hope. In fact, the disease of itself seldom destroys life, except through the effects of mixed infections. Tuberculosis of the meninges may prove fatal without the aid of other germs; and yet advances in brain surgery show that it may be possible to give relief even in this condition.

It is most unfortunate that tuberculosis is so prone to affect the

* Reprinted from the "Proceedings of the Congress."

young and the middle-aged, during the productive period of life. For an adult to become dependent upon sympathy or aid of any kind—be it medicine, crutch, or unearned money—is a serious matter. To be physically sick is bad enough, but is not to be compared with that lamentable condition—the mental disability of the chronic invalid.

While medicine is a science, in many particulars it cannot be exact, so baffling are the varying results of varying conditions of human life. There is still much discussion in the medical profession, as well as among the laity, as to the manner in which the infection enters the body—whether through the skin, or the respiratory or alimentary tract—and how long it may lie dormant before manifesting its usual signs. Some distinguished investigators have encouraged the public to disregard the danger of infection from animals. One might say, in a general way, that it would be better to consider several sources of infection as possible (which is our present belief) than to neglect any of the accepted preventive measures, since at best it is a difficult matter to attain high standards of practical hygiene.

Infections of all kinds develop toxins peculiar to themselves which cause the blood to produce anti-bodies. It is by means of this reaction of the blood against toxin that we secure our varied vaccines. Many individuals have a high resistance against tuberculous infection; there are many, however, in whom the blood fails to develop the reaction which would cause the tubercle bacilli to be destroyed, thrown off, or even walled in, as usually occurs in common infections.

While we review the various methods of treatment which represent our heritage from the past for the so-called “cure” of tuberculosis, it is well that our attention should be directed to the future, with its sanguine hope. The failures of the past have fulfilled their mission in the progress of investigation, and possibly we should not call them failures.

The disease is many-sided. Medicine still holds first place in its treatment, but more and more, as time passes, the physician's plan of treatment in cases of tuberculosis includes various instruc-

tions to the patient, which mean nothing more than the observance of simple methods of correct living. We are witnessing extensive experimentation in the endeavor to develop a higher resistance to the disease. In the animal world the results are extremely gratifying.

Serum-therapy is again claiming wide attention, notwithstanding its many failures in the past; while the use of filtrates and attenuated living tubercle bacilli has many advocates who report success. In certain forms of joint tuberculosis these serums and vaccines have a distinct value. Their use offers no difficulty, and they are at least more promising than the various non-specific injections which are used in the hope of developing better repair than can be accomplished by the patient unaided, or aided only by general hygienic treatment.

Surgeons have learned that pure tuberculous accumulations must not be removed without great care to prevent mixed infection. By many failures, we have learned that it may be harmful to operate on local tuberculosis during the acute fever of recent infections, and that the treatment along general lines must make good progress before repair by surgery can be expected. Through failure to recognize such unfavorable conditions, ill-timed operation often results in a rapidly disseminating general tuberculosis.

So each plan of treatment has its application in some type of tuberculosis, though the seeming strife among the advocates of various methods leads the public to believe that we are disagreeing among ourselves. The ability to consider all the circumstances, and to select the best method of treatment for the individual patient, and the tact and skill with which the treatment is carried out, determine the results of surgical intervention, and, according to these results, surgeons are graded.

In these days we are admitting the general public to share fully in all we know about tuberculosis, and this publicity has developed a strong sentiment which will improve our legislation on foods, especially meat and milk, and will strengthen other sanitary legislation. The era of a national bureau of public health is now approaching. Publicity on this subject has brought about improve-

ments in the care of sleeping-cars, has greatly diminished the evil of expectoration in public places, and has extended to the farm, where serious efforts are made to exterminate and to prevent tuberculosis among animals. In some communities a morbid fear of the consumptive has arisen, and, while this adds to the burdens of affliction, it is, perhaps, unavoidable; it will pass away in time, and, on the whole, it is undoubtedly for the public good, tending toward the ultimate control of the disease.

PRESENT-DAY SURGERY IN ENGLAND AND SCOTLAND; FROM NOTES MADE ON A RECENT SHORT VISIT*

By WILLIAM J. MAYO

There is an erroneous impression in America that surgery in Great Britain is not modern, and that, in order to see good technic, England should be passed for the Continent. To the student who speaks French and German, France and especially Germany offer great attractions; but that they do not contain all that is worth seeing in surgery is readily demonstrable by a short visit to the British Isles.

Lister met the fate of all prophets and failed to get a hearing in England, but he was appreciated in Germany and became established there years before his theories were taken up in the land of his birth. To-day antiseptic and aseptic methods are the rule in Great Britain, and it is observed in the breach not more often than occurs at home or in Continental Europe.

While it must be admitted that many of the surgeons in the great hospitals of England are exceedingly conservative, yet it must also be acknowledged that they are very sound, and one does not often see them doing operations based upon indefinite symptoms. To a certain extent the misapprehension as to the character of English surgery has been founded upon "a few days in London" by some American students, rather than upon real investigation as to the general conditions, particularly in the smaller cities. London does not represent English surgery in the way that Paris represents the surgery of France. Men who occupy the chief positions in the London hospitals, have gained them, to a considerable extent,

* Reprinted from "The Journal of the Minnesota State Medical Association and Northwestern Lancet," Dec. 1, 1907.

through long years of patient waiting and working in subordinate positions. By the time they become leaders, their work is more or less crystallized; and, unfortunately, in many hospitals there is no machinery, such as an age or time limit, whereby these men may be retired. Under present conditions it is nearly impossible for a man from the provinces, no matter how great his ability, to obtain a position on the staff of any of the London hospitals; and, as a matter of fact, a man can seldom change from the staff of one hospital to that of another, which is quite contrary to the best German traditions. This does not mean that the general average of surgical work in London is poor, but it does mean that some of the most modern surgery is to be seen in the provincial towns.

Hospitals.—All of the hospitals are supported by voluntary contributions. Very few of them have any endowment, and those that do have, like St. Bartholomew's, find the same wholly inadequate. This being the case, practically all of the work done in the hospitals is for charity, and each hospital must make a big showing in order to stimulate contributions. There is a marked tendency in this condition to do great injustice to the physicians who practise in the neighborhood. By the misappropriation of funds committed to the trust care of hospital directors for the purpose of taking care of the worthy poor, charity is in many instances diverted from its proper channels to the giving of free service to people who can afford to pay—a condition of hospital abuse with which we are quite familiar at home. The whole scheme of English hospitals makes no provision for the honest man in moderate circumstances. He must either swallow his pride and accept misplaced charity, or take refuge in a nursing-home where the charges are high and the service exceedingly poor. The common people, who have made England what she is to-day, do not receive the care and attention which are given to the tramp or the bar-room loafer.

The size of the British hospitals varies from about 200 to 850 beds. They are fairly clean and the food is good. The nursing seems satisfactory. Each hospital has a three-year course of training for the nurses. Generally speaking, however, I do not think that the English hospital service is quite up to the best

American standards, but as nearly all of our hospitals take pay patients, it is hardly fair to make direct comparison, unless it be with some of the American hospitals that are entirely devoted to charity work.

The operating theaters are nearly all modern and well equipped. About one-half of the surgeons wear rubber gloves and require their chief assistants to do the same. Nearly all operators wear caps, but very few of them have any protection over their faces while talking. I was glad to see in many of the hospitals that the nurses were compelled to wear a head-covering in the operating room instead of allowing their hair (some of it their own) to fly about their heads in the barbaric manner prescribed by modern style. It is certainly incongruous that an operating-room nurse should be covered by a gown, rubber gloves, and sleeves, and yet allow her hair to fly in every direction, like shaking a hair duster over things she is supposed to protect.

Throughout Great Britain chloroform is used almost exclusively as an anesthetic. Ether is very seldom given, except by the few men whose work I shall speak of more in detail later.

Silk is rather generally used as a ligature and suture material, only a small number of the more advanced surgeons using catgut, while the old-fashioned sea-sponge is still the favorite. For hand-cleaning, lysol solution is used extensively. Iodoform is used more freely in wounds than it is in America. It is kept in a solution of bichlorid, 1 : 1000, and is scooped out of this and used with enough of the solution to make a paste.

Many of the operating rooms are quite sloppy and wet, so much so that the surgeons wear short rubber boots on account of the excessive use of irrigation, etc. Practically all of the more advanced surgeons whom I saw, however, operate in most modern fashion and conduct their operating theaters in every respect as they are conducted here.

Medical Education.—Most of the large hospitals conduct medical schools, although only a few of them are connected with universities, and can give the title of M. D. The licensing bodies are, fortunately, independent and require only the licentiate degree to

permit the practice of medicine. This has thrown all of the examinations for university degrees into the hands of a few institutions, such as Oxford, Cambridge, and Edinburgh; however, most of the provincial cities have recently organized universities of their own, which grant titles, such as that of M. D. (a purely university degree). A surgeon, however, cannot expect a hospital appointment if he is not a Fellow of the Royal College of Surgeons.

Comparing the general course for the students with that of our best schools, it can be said that the English student is taught the fundamental branches, if anything, more thoroughly than they are taught here. Their students will be found to be first-class anatomists. Their courses in gross pathology are also most excellent—far better than the average course with us. The English student knows what he sees with his own eyes, while the American student is educationally tied to his microscope. I believe that in this respect the English student is better taught, even though the American laboratory courses are technically more extensive.

LIVERPOOL

Liverpool has three hospitals: the Royal Infirmary, 280 beds; the Northern, 220 beds; the Southern, 208 beds. The surgical service in the hospitals is divided into three divisions of from 40 to 50 beds each. The chief surgeon of each division has continuous service, getting all the patients admitted on two days in each week. Each surgeon has one regular operating day a week.

There are a number of very excellent surgeons in Liverpool. I had the pleasure of seeing Mr. Grimsdale of the Royal Infirmary, Mr. R. W. Murray of the Northern, and Mr. Robert Jones of the Southern, the latter a nephew and most worthy successor of the late Mr. Thomas, known the world over as the originator of the Thomas hip-and-knee splint and the Thomas wrench, used so much by orthopedic surgeons. Mr. Jones' clinic is most extraordinary, and is very largely the surgery of deformities. Just as Lawson Tait carried sound surgery into the abdomen, and Mr. Victor Horsley into the cranial cavity, so has Mr. Jones carried sound surgical principles into orthopedic practice, and rapid cures

are the result in a large number of cases which were formerly treated for months and years by orthopedic apparatus. This does not mean that Mr. Jones has discarded these measures. He is most careful in the after-treatment, and uses mechanical contrivances for their proper purposes, as an adjunct to surgery, not in place of it. In tuberculous joints he is especially conservative.

Mr. Jones' working organization is very good indeed. His offices occupy a large house and include a staff of about a dozen people. Here he sees every morning from 30 to 40 patients. The general examinations, the taking of histories, etc., are done by assistants in one of the numerous small rooms. Mr. Jones examines the patient, comes to a decision very promptly, and makes the recommendation as to treatment; the details of arrangements for operation, etc., being carried out by another person. A great many patients are operated upon during the morning in the office, and leave the building in the course of the day. One morning while visiting him in the office, I saw him reduce two dislocations of the shoulder, set some fractures, and operate on several cases of club-foot in babies. In the afternoon, five days in the week, he operates on private patients in nursing-homes (a small hospital conducted by private enterprise, usually by several nurses). Sunday is his free clinic day, when fully 200 or 300 patients are examined free of charge. Many of them are sent into the Southern Hospital for his public clinic, which is given, at the present time, once a week. He operates on that day upon from 15 to 30 cases, a great many of whom are not kept in the hospital. In osteotomy, club-foot, and similar operations the patients are allowed to go home after recovering from the anesthetic. All operations are done under ether anesthesia. The asepsis is most painstaking and thorough. He is expeditious, yet neglects not the smallest detail, and his wonderful experience enables him to do wizard-like operations with a precision that is startling. So unassuming and modest is the man that he is, I believe, entirely unaware of his great ability. One thing that interested me very much was his treatment of fracture of the elbow. He told the mother of the patient (a little girl) that he would give the child, who had a comminuted fracture,

a useful arm, but told her the elbow might be flattened out and unpleasant in appearance; or, if she desired, he could give the child a normal-appearing elbow with some loss of function. The mother wisely chose the function with deformity, and he laughingly said, "they usually do." He puts these elbows up in flexion, and continues the manipulation until it can be done with ease. This pushes the fragments out of the road and restores permanently the hinge-function of this important joint. He does not use passive motion until it can be done without pain, but at the various dressings he varies the angle.

All splints are as cheap as possible, being made from malleable-iron sheeting. Instead of adhesive straps, he uses a pitch plaster, which is very cheap and is made on the premises. A pitch paper is also home-manufactured at a very small expense.

I must place Mr. Robert Jones as one of the greatest surgeons it has been my good fortune to meet. He belongs to that type of specialist who has been, and continues to be, a general surgeon, but has been forced by the large amount of work to become a specialist, and so Mr. Jones is working almost exclusively along orthopedic lines.

EDINBURGH

The present-day conditions in Edinburgh for surgical study are extremely good, and maintain the high tradition of the old University. There are 1400 medical students, and the group of medical buildings is quite imposing. The Royal Infirmary, containing 850 beds, is separated from the medical buildings by only a narrow street, and its patients are used for clinical instruction. The service is divided into six divisions, each surgeon having under his immediate control wards containing from 40 to 50 patients. There is a separate gynecologic service.

It is unfortunate that there is no age limit for the retirement of division heads, since the present system tends to their retention after their usefulness has departed, and the consequent delay in the advancement of the younger men. This will be remedied in the future by the surgeons themselves, who have by unanimous

agreement changed their positions from life-appointment to retirement at the age of sixty-five years.

Mr. Annandale is the professor of clinical surgery. His achievements maintain for him a high place in the esteem of his countrymen. Professor Chiene is very active, delivering an average of five lectures a week and holding two clinics. From the standpoint of the student, as a lecturer on surgery he is probably not excelled by any man in Great Britain. He is of imposing presence and is a most inspiring speaker. To the active surgeon, however, the younger men will appeal more strongly.

Mr. Stiles has the largest amount of surgical work of any man in Edinburgh. He is the chief surgeon of the Children's Hospital and Chalmers Hospital, and has a private infirmary, giving him, in all, not far from 100 beds. He is forty-five years old, an indefatigable worker of the American type, and is well known to us as the translator of Kocher's "Operative Surgery." He is rapid, exceedingly accurate, and has no frills of any kind. I was much impressed with his thorough knowledge of pathology and his unwavering devotion to the welfare of patients. He is a man so honest he would not know how to play "to the gallery." I attended a number of his clinics and found them most attractive and profitable. He called my attention to some very interesting cases. One was congenital hydronephrosis in a child, forming a large cystic tumor most confusing in diagnosis, as the tumor was apparently abdominal. Another was a rare case of Hirschsprung's disease, or chronic dilatation of the colon, especially of the sigmoid, congenital in origin. The third was infantile congenital stenosis of the pylorus, of which cases Mr. Stiles has operated upon somewhat over forty. These were seen at the Children's Hospital. Another class of operations in which Mr. Stiles is very much interested concerns the ligation of both common carotids, at intervals of ten days, for the cure of chronic hydrocephalus in infants. He has had two or three remarkable results. He believes in early operation for hernia when the hernia cannot be held up with a truss, and has operated on over 800 infants with rupture, with most excellent results. He does not use any dressings after such hernia

operations. A "cage" is placed over the child to keep the bedding from the wound, the hands and arms being gently controlled by appropriate bands.

At Chalmers Hospital I was much interested in a case in which he removed the entire lower jaw, tongue, and anterior wall of the pharynx. The glands were removed extensively, and also a section of the internal jugular vein. Although the deformity was horrible, the patient was alive and in excellent health after a number of months.

I had the pleasure of seeing Mr. Alexis Thompson do considerable work. He is a brilliant operator, and makes rapid knife-dissections with exquisite delicacy. In addition to his junior position at the Royal Infirmary, he is chief surgeon at the Deaconesses Hospital. His aseptic arrangements are perfect and are carefully carried out. He showed me a number of cases, and among them was a patient from whom he had removed the greater part of the stomach for cancer in the pyloric end. This patient has remained well for more than nine years. He has a little trick of winding a couple of feet of catgut around the second joint of the great finger of his left hand, which he uses as a spool, so that he can tie a large number of blood-vessels very rapidly.

Mr. Davis Wallace is another of the junior surgeons who is making a reputation. He is a very rapid operator and has done a great deal of splendid work. I recollect one evening when he was out for dinner that he drove a mile to the Royal Infirmary, successfully operated upon a case of traumatic rupture of the intestine, and was back at the dinner-table after an absence of only an hour.

To a student who is going abroad for the purpose of seeing surgery, Edinburgh presents favorable opportunities. The museum connected with the Royal College of Surgeons is among the best in Europe.

The anatomic laboratories are under the general charge of Mr. Cunningham (author of Cunningham's "Anatomy"), one of the finest teachers of anatomy in the world. I spent several hours with him most profitably, and was particularly interested in his work on the comparative anatomy of the stomach and rectum, studied from an evolutionary standpoint.

NEWCASTLE-UPON-TYNE

At Newcastle is the Victoria Hospital, with nearly 600 beds. The surgical service is divided into four sections, each surgeon having about 50 beds.

Newcastle's foremost surgeon is Mr. Rutherford Morison. Mr. Morison is original in his methods and is a bold and skilful operator. He favors a very large incision to secure good exposure, and cross-cuts muscles extensively. For gall-bladder work he makes nearly a transverse incision parallel with the right costal margin, and of tremendous extent. In acute appendicitis he also cuts the muscles widely, and always removes the appendix. I saw him do pelvic and abdominal work and also some perineal plastic work in a most able manner.

I was much pleased with Mr. G. Grey Turner, one of the junior surgeons. He is a most accomplished young surgeon, clean, skilful, and possessing a splendid knowledge of pathology. For some years he acted as curator of the pathologic museum. I saw hundreds of specimens which he had mounted, many of them for teaching purposes to show pathologic conditions in their association; for instance, a contracted kidney, the second kidney without a capsule, cross-sectioned, and a large section of the heart showing hypertrophy—all from one subject.

Gynecologic service in this hospital has but four beds, the operative work being done by the general surgeons.

At Newcastle I attended a meeting of one of the branch societies of the British Medical Association which was given up almost entirely to clinical and laboratory work and to the exhibition of pathologic specimens.

LEEDS

The General Hospital at Leeds has between 500 and 600 beds. The surgical service is divided into four sections, each surgeon having 50 or more beds. Leeds has been one of the leading surgical centers of England for a hundred years. Among its distinguished men are the Hey family, father, son, and grandson, followed by the Teals, father and son, succeeded by Mr. Robson, and later

by Mr. Moynihan and Mr. Littlewood when Mr. Robson moved to London.

Mr. Moynihan is an exceedingly able surgeon and carries his antiseptic technic to an extreme degree, even to the extent of fastening gauze protection to the margin of wounds. He operates twice a week at the Leeds General Hospital. Friday is his main operating-day, when he has at least five abdominal cases. His technic is of the highest order and follows a definite plan. I saw him do some stomach and gall-bladder work, and was particularly pleased with a partial gastrectomy which he performed for cancer. The dissection of the glands was very careful and complete, particularly about the pylorus and along the superior border of the pancreas. After closing the duodenum, the gastrojejunostomy was made on the posterior wall of the stomach before the tumor was cut away, the amputation and closing of the stomach being the last thing done.

BIRMINGHAM

Birmingham has a very beautiful modern hospital, but, with the exception of Lawson Tait, no great surgical traditions. It has two surgeons of eminence. Jordon Lloyd, the more notable of the two, was, unfortunately for me, away on his vacation. I was fortunate, however, in seeing Mr. Gilbert Barling do some excellent work.

LONDON

London has so many fine hospitals and such a wealth of surgical material that it is difficult to know where to begin to describe it. I shall therefore mention only a small amount of the work that appeared to me as being particularly good. I would place Mr. Robson first. While he has no hospital appointment, he does a large amount of private work in nursing-homes. A profound scholar and an experienced operator, it is a pleasure to see him work. He very seldom drains gall-bladder or common-duct cases through the abdominal incision, but rather through a stab-wound near the tip of the floating ribs, tube-drainage being used nearly exclusively. If any gauze is used, it is a very small strand inside the tube to drain the space outside of the gall-bladder. He does

cholecystenterostomy by suture without button or bobbin, and in all of his common-duct cases he does not rest satisfied until he has passed a large probe through the common duct into the duodenum.

At the Temperance Hospital I saw Mr. Paterson do some very clever operations upon the stomach and upon the large intestines. Mr. Paterson is a fine pathologist and his work is based upon sound principles. He has written largely upon the surgical diseases of the stomach—"Hunterian Lectures" (1906), etc.

Mr. Paterson's medical associate is the justly celebrated Soltan Fenwick, the widely known author of works on ulcer and cancer of the stomach.

At St. Peter's Hospital, which is devoted to male genito-urinary diseases, I saw Mr. Pardoe remove the entire prostate and prostatic urethra for hypertrophy through a suprapubic incision. A very large rubber drain was then introduced, to be left for four days, after which the wound would be allowed to granulate. In removing the prostate gland the finger of the left hand is used in the rectum to raise the gland up, and a great deal of force is used by the one or two fingers in the bladder to lift the organ from its bed. The crushing operation for stone in the bladder is used almost exclusively.

St. Thomas's Hospital is the only large hospital in London in which asepsis is used exclusively. Here I saw Mr. Makins operate on a number of interesting cases. He seemed to be the sort of surgeon that one would trust to operate upon oneself or family.

At King's College Hospital, of which Mr. Watson Cheyne is the leading surgeon, antiseptic surgery is practised. In all the other hospitals antiseptis and asepsis are used in combination.

At the National Hospital for Epileptics I saw Mr. Victor Horsley remove a cystic tumor from the pituitary body. In brain work he usually turns down a large osteoplastic flap and stitches it back into place, waiting four days before attacking the tumor. He says that the sudden temporary failures on the operating table are due to collapse, not to shock, and calls attention to the fact that true shock comes on slowly and lasts a number of hours. He says

that the closer one gets to the base of the brain, the greater tendency to true shock. He is a great believer in spinal surgery, and operates extensively on spinal diseases as well as injuries. In his peculiar line of work, Sir Victor Horsley has no equal. I left his clinic with a feeling of profound admiration for the man and his work.

SOME PRACTICAL POINTS IN THE PHYSICAL EXAMINATION*

By H. Z. GIFFIN

It is my object to review certain procedures connected with the making of a general physical examination—procedures which, though simple, seem to be more important than striving for fine clinical data of questionable value. The old saying, that more mistakes are made in diagnosis on account of a lack of observation than on account of a lack of knowledge, still seems to hold; consequently the points to which I wish to call your attention are not new, and the real plea should be for complete examinations by at least all of the simple and direct methods at our disposal.

First, as to the making of rectal observations. We seem to have a real antipathy toward putting the finger into the rectum, and yet we all acknowledge that no examination is complete without doing so. The sad cases of carcinoma which have been treated over a period of months for piles, simply on surmise, are more numerous than we would suppose, while the intelligence of the patient and the real ability of the doctor seem to cut little figure.

Generally it is possible to satisfy one's self by the digital examination or by a careful questioning as to the character and frequency of the stools. When this information is not conclusive, a glass jar with tightly fitting top may be provided in which a sample can be brought for gross inspection. If this seem to indicate blood coming from a part higher up than the anal region, a proctoscopic examination, after a laxative has been given, can be more easily made than many of the finer chemical tests upon which time is

* Read before the Southern Minnesota Medical Association, August 6, 1908. (Reprinted from "The Journal of the Minnesota State Medical Association and The Northwestern Lancet," Sept. 15, 1908.)

often wasted in every practitioner's laboratory. Rarely will the case appear which requires the more difficult sigmoidoscopic examination of the expert. The use of the proctoscope, like that of the ophthalmoscope, will yield more definite and fruitful results in the hands of general practitioners than many more widely exploited diagnostic methods. Unlike the cystoscopic examination, it requires little of the skill that is difficult of attainment.

The above discussion leads us directly to the much-neglected study of the diarrheas and bloody dysenteries. In these conditions inspection of the lower bowel will reveal either a diffuse inflammation, ulceration, or a normal mucosa. Although it is impossible to arrive at definite conclusions in many instances as to the causative agent, even with all the practical methods at our disposal, nevertheless I fear we are neglecting to study the feces as we should. The man who can examine sputum without nausea can surely study the feces; moreover, one acquires a certain immunity toward noxious odors and disturbing sights. A saline can be given and a watery stool obtained. This insures the best specimen in a search for parasites, and is the method employed in Manila. The specimen should be obtained by means of the rectal tube or the stool passed in the physician's office and examined while yet warm. It has been possible in this way for me to recognize two cases of amebic dysentery during the last year which have come from towns in Minnesota. There is no doubt that a few of our chronic dysenteries are amebic. Much more common, of course, is the watery or bloody tuberculous diarrhea, and it should be emphasized that many tuberculous diarrheas are watery. The saline purge will often bring down tubercle bacilli, and these can be found in an ordinary smear. It is surely worth while to employ these means of investigating the stool, though half of our cases of diarrhea and dysentery still remain unidentified. Most of the unidentified will be in reality pyogenic, diffuse, or granular forms of colitis, many of them due to the colon bacillus; others will be nervous in origin.

In cases of suspected pancreatic disease, bacon can be fed and the excessive amount of undigested fat looked for in the stool.

The making of a pelvic examination in girls up to the age of twenty by way of the vagina is often impossible on account of the unruptured hymen, and even when possible is unsatisfactory on account of the muscular rigidity attendant upon nervousness, and yet a pelvic examination is necessary before arriving at a positive diagnosis of any abdominal condition. In these cases examination bimanually per rectum is by far the easiest and most satisfactory method. It may at first be difficult to interpret the findings, but with some experience the cervix can be located, the position of the uterus ascertained, its movableness tested, and the presence of any tumor made out. Occasionally a girl of fourteen to sixteen comes to us with a diagnosis of chronic appendicitis. The history may be typical, and no positive abdominal sign of tumor can be detected, but upon pelvic examination per rectum an ovarian tumor is found, and at operation the appendix is normal. This has happened with a tumor even on the left side. It may be objected that permission for such examination may not be given, but if one proceeds in a businesslike manner to whatever examination he desires to make there is usually no difficulty. Not many years ago the woman who would submit easily to a pelvic examination was considered immodest. Fortunately, this is no longer the case, and even in young girls such an attitude is at present considered false modesty. In fact, more complaint is likely to be made on account of incomplete examination than otherwise.

Another point in connection with rectal examination is the great importance of the bimanual method in men, the patient being placed upon the back with the legs drawn up. Masses can be discovered or more accurately outlined in this way, and as far as I have been able to observe in different clinics it is not frequently used. A man of twenty-two came with a history of injury to the right inguinal region six weeks previously, followed by an attack of fever, which was considered typhoid, and later by rather colicky pains, more on the right side, so that a diagnosis of chronic appendicitis had been made. Upon rectal examination, however, in the above position a mass was found in the pelvis which seemed to be attached to the pelvic bones. It felt rather like sarcoma or old

inflammatory tissue. The x-ray was negative, and the mass gradually disappeared of itself without operation or treatment. It had undoubtedly been an infected hematoma caused by the injury, and pelvic examination saved us from the mistake of operating.

A man of forty-five came with a history of pain low in the abdomen, more on the left side. There had been no obstructive attacks and no passage of macroscopic blood by stool, although there had been some diarrhea. A sigmoidoscopic examination revealed only some injection of the bowel high up. No tumor was palpable abdominally, but there was some suggestion of resistance. There had been little loss of weight. Upon pelvic examination bimanually, however, a mass the size of a hen's egg could be most clearly outlined, while by the usual method with the patient upon his knees nothing could be felt. A diagnosis of probable carcinoma of the sigmoid high up was made and at operation this was confirmed.

It is chiefly in such cases as these, where abdominal findings are not altogether satisfactory, that pelvic examination in men yields most valuable information, and it is surely more reasonable to develop the habit of following such easy methods in diagnosis than to make elaborate tests, to the possible exclusion of certain direct observations.

Dr. Richard Cabot, of Boston, advocates the examination of the abdomen with the patient in a warm bath. This relaxes the abdominal muscles, thereby permitting the detection of tumors, especially in those cases of extreme abdominal sensitiveness and rigidity. The method is most practicable in private practice when a tub can be obtained. A single trial will convince one of the amazing ease with which palpation can be carried out. It is quite likely that some of our doubtful cases of carcinoma of the stomach can be positively diagnosed by the simple palpation of a tumor in this way.

A purge should be given to stout people and to all patients whose bowels have not moved freely. This is a necessity in abdominal and pelvic cases before a final conclusion is reached if the condition be at all indefinite. The cleaning out of the bowels renders palpation easier and the findings more clearly ascertainable; indeed,

in certain instances it will clear away what had formerly been considered a pelvic tumor.

Routine testing of the reflexes, more particularly of the knee-jerks, is worthy of insistence. This can be done without fail if one have a systematic way of going about his examination, and in most cases requires merely a tap with the edge of the hand.

Gastric crises are frequently overlooked in the diagnosis of abdominal conditions, and we all know of many cases of locomotor ataxia that have been operated upon. Ulcer had been suspected, but probably an innocent appendix was removed. Crises, when they come repeatedly and at irregular intervals, laying the patient up in bed and causing the vomiting of all food taken, may easily be mistaken for ulcer if we have not obeyed the law of complete observation by testing the knee-jerks and pupils and looking at the eye-grounds. The ophthalmoscope is not frequently needed by the general diagnostician, but its importance is of such positive value that it is indispensable to him.

It is, of course, a simple matter to examine the breasts of all cases, even though they come for some remote trouble, and this examination will be most productive in a prophylactic way. In a month I have found four unsuspected tumors of the breast, one of which upon pathologic examination was found to be carcinoma. At the present time, when we know that almost every breast-tumor should be removed on suspicion, and when the results after early operation are so uniformly good, this evidence becomes most important. With us in every case the breasts are examined, because we consider that some of the most effective work of a physician can be accomplished by finding the disorder which the patient neither complains of nor suspects. In this way a system of prophylaxis may be established, and it is our duty to ferret out the prospective, as well as the imminent, danger if we undertake the care of a case.

Appendicitis is a disease of such common occurrence that one must guard against its diagnosis without sufficient inquiry into urinary symptoms and without a sufficiently careful examination of the urine. The urinary tests can be directed mainly toward

the search for blood, and the surgeon can be assisted by a history of any urinary findings which may lead him to desire a cystoscopic or x-ray examination before operation. The number of cases in which the appendix has been removed and in which ureteral or kidney-stone is later found continues to be larger than it ought to be. Likewise intermittent hydronephrosis must not be forgotten, and the radiation of the pain inquired into. The cases have frequently had the gall-bladder drained or the appendix removed before the real lesion has been discovered.

Passing now to a more strictly medical disease, I know of no more difficult task than finding the fundamental cause of some of the severe anemias of the secondary type. Anemias due to nephritis or malignant disease or hemorrhage are comparatively simple, but there remains a group of cases which one cannot place without the pernicious anemias and in which the cause remains obscure. These are thought to be due to septic conditions in some part of the body, and in their treatment I wish to emphasize the importance of nasal inspection. An antrum full of pus or a frontal sinusitis is sufficient to keep the blood in an impoverished condition, and the part played by these nasal affections is not generally recognized. We have had many cases in which the hemoglobin was below 50 per cent. that have had no recurrence of their anemia after proper nasal drainage. There is an element of truth in the poisoning of the system by "catarrhs" which our quack-medicine venders so delight in explaining in detail.

In concluding this ill-jointed paper, let me reiterate the importance of never neglecting any of the direct and simple methods and the importance of forming the habit of making complete examinations; the necessity of rectal observations and a more spontaneous interest in the feces; the value of the bimanual method of examining the pelvis in men and the pelvic examination per rectum in girls; the need of finding the septic focus in our cases of anemia, and recognizing the signs of disease of the nervous system in what are, at first sight, abdominal disorders when symptoms may least point the way; and, last, to develop a system of prophylaxis in regard to cancer of the breast by allowing no breast-tumor to escape our observation. All this to the end that we may avoid later embarrassment and develop a more exacting medical conscience.

A PLEA FOR THE EARLY DIAGNOSIS AND EARLY SURGICAL TREATMENT OF CANCER*

By E. H. BECKMAN

The fact that one of the best known surgeons in America has recently died of metastatic cancer, which had its origin in the mouth, is simply an illustration of the helplessness of the medical profession in curing the disease when it has become disseminated through the body; but that he could die of this disease without surgical treatment shows that the profession is not profiting as it should from the evidence produced by the best surgeons as to the curability of cancer when properly treated surgically in its incipient stages.

Cancer is almost the only disease which is steadily and rapidly increasing among the civilized races. The medical profession, with the aid of the press, the national government, and the various antituberculosis societies, has finally succeeded in reducing the mortality from tuberculosis. Cancer, at its present rate of increase, will soon be more fatal than tuberculosis, and yet no great movement has been placed on foot to bring before the profession or the laity the known facts regarding cancer and its cure.

In England the statistics for 1905 show that cancer is more fatal to women than tuberculosis, there being 100 deaths per 100,000 from the former disease, to 94 from the latter. The English statistics further show that, while at present more women are affected with cancer than men, the proportion of males having cancer has increased more rapidly since 1850 than of females. Omitting carcinomas of the breast and uterus, the disease is more

* Read before the Minnesota Academy of Medicine, November 3, 1909. (Reprinted from "The Journal of the Minnesota State Medical Association and The Northwestern Lancet," Dec. 15, 1909.)

common in the male than in the female. The English statistics for 1906 show that 1 in 11 of all men and 1 in 8 of all women thirty-five years of age and upward eventually die of cancer. The statistics for the United States are not as complete as for England. They show that the deaths from malignant disease in 1850 were 9 per 100,000, while in 1900 they had increased to 43, or nearly fivefold in fifty years.

The deaths from cancer alone in 1890 were 47 per 100,000, but had increased to 60 per 100,000 in 1900. The deaths from tuberculosis in 1890 were 245 per 100,000, but had decreased to 187 per 100,000 in 1900.

The number of deaths from cancer in Minnesota for the year 1908 was 1258. This shows, when compared with the total mortality-rate, that 1 death in 17 is due to cancer.

While the death-rate in the United States from tuberculosis is still greater than from cancer, it is rapidly decreasing, while that from cancer is on the increase. The United States Census Report for 1900 shows that 1 in 29 of the total deaths is due to cancer. These figures point out the enormous prevalence and the steady increase of cancer. They are certainly evidence enough to make the subject one of personal consideration to every one.

Bashford, in a recent article, is of the opinion that most of the increase in cancer is apparent rather than real, and is due to more reliable statistics rather than to an actual increase in the disease.

Although hundreds of competent and enthusiastic workers are endeavoring to discover the etiology of cancer, up to the present time its cause is still unknown. The various theories—the microbic, the protozoan, and others—are not proved. We cannot hope, then, to learn how to cure cancer by a study of our present knowledge of its cause. The most optimistic internist cannot claim a single cure. Serum-therapy and immunizing vaccines, which have revolutionized the treatment of many diseases, have been of no help in this disease. The *x*-ray, which at first promised so much, is now regarded by those most competent to give an opinion as of little value except in the most superficial cases of skin cancer. The treatment of carcinoma by radium is still in the experimental

stage. The pathologic study of cancer, while teaching much in regard to the mode of growth and spread of the disease through the body, has aided in the cure only so far as it has been an aid to the development of the surgical treatment.

At the present time surgery is the only branch of medicine that holds out any hope for the cure of cancer. It is of the utmost importance, then, that every member of the medical profession should know just what surgery has accomplished and what can be expected of it in curing this common disease. The profession has before it two duties to perform: (1) to inform itself and (2) to educate the people. Let us study some of the common forms of cancer, see what percentage of cures surgery gives, and endeavor to learn how the percentage of surgical cures can be increased.

One of the commonest sites of cancer in the female is the breast. At a meeting of the American Surgical Association, held in May, 1907, a symposium on cancer of the breast showed that the percentage of cures following the radical operation was from 20 to 40. In cases where the axillary glands were not involved at the time of operation the percentage was increased to 70 and 80.

One of the most complete reports of recent times is that of Drs. Greenough, Simons, and Barry on operations for cancer of the breast, performed at the Massachusetts General Hospital for ten years, from 1894 to 1904. This report includes 376 cases, which have been traced for an average of eight years following operation. It includes both complete and incomplete operations. The total percentage of cures is 20. The percentage of cures during the last five years covered by the report, when more complete operations were performed, was 26, as compared with 16 per cent. during the first five years. One of the conclusions of this report is especially significant, viz., that incomplete operations on early cases yielded better results than extensive operations on cases which were well advanced.

The conclusions to be drawn from the above facts are that, to obtain more cures, cancer of the breast must be removed by the complete operation, and at the earliest possible time.

Eighty per cent. of the tumors of the breast are or will eventually

become malignant. No member of the medical fraternity has developed a keen enough sense of touch to positively state from palpation that a tumor of the breast is not malignant. These tumors must all be regarded as suspicious until proved benign. A doctor who tells his patient with a growth in the breast that she has nothing but a tumor, and keeps her under observation until the axillary glands are involved, and then hurries her to a surgeon, deserves to be censured much more than the one who gets a poor result from reducing a fracture, for in the latter instance it means a useless member, but in the former it means death in 80 per cent. of cases.

The laity should know that every tumor in the breast is a pathologic process, that absolutely nothing can be gained by expectant treatment, and that in almost every instance delay lessens the chance of cure. It is better to remove scores of benign tumors than to let one patient pass the stage in which cure is possible.

Freedom from pain leads many patients with cancer into a sense of security. The public should be taught that cancer is a painless disease, and that pain comes late from adhesions, ulceration, and inflammatory thickening about the tumor. If the above facts were generally known, the percentage of surgical cures of cancer of the breast would more than double in the next few years.

Cancer of the uterus, like cancer of the breast, must be operated upon early to save the patient's life. When the disease has spread to adjacent structures, the case is almost always hopeless, so far as obtaining a cure is concerned. Women should be taught that a persistent foul vaginal discharge is always suspicious of cancer, and that any flow after the menopause is almost pathognomonic of this disease.

Cancer of the lip is a common form of cancer in males. It invariably starts as a small chronic ulcer which undergoes carcinomatous change. If operated upon before metastasis has occurred in the lymphatics of the neck, by an operation which includes the removal of all the gland-bearing tissue of the anterior triangles of the neck, the prognosis is decidedly favorable. If, however, the lymphatic glands of the neck are involved at the time of operation,

the prognosis is decidedly grave. The profession should not recognize a surgeon who treats a cancer of the lip by removing the growth and does not at the same time remove the lymphatics of the neck. He should be classed with the quack who applies paste.

We must educate the public to realize that any ulcer of the lip which does not heal readily under treatment is almost surely cancer, and should be removed at once for microscopic examination. If the examination reveals the presence of carcinomatous change, then the lymphatics of the neck must be removed also.

The pathologists at St. Mary's Hospital have definitely proved that cancer develops upon ulcer of the stomach. Seventy-one per cent. of the cancers of the stomach excised at the Mayo clinic show that they have developed upon ulcer. A patient with chronic ulcer of the stomach, then, who does not improve under medical treatment in a reasonable length of time, should be advised to have a surgical consultation on account of the danger of carcinoma developing upon the ulcer. Here, as in cancer of other regions, the patient's only hope of cure is in an early operation.

Summary.—1. Statistics show that cancer is increasing among all civilized races.

2. English statistics show that 1 in 15 of all men and 1 in 9 of all women thirty-five years of age and upward eventually die of cancer.

3. Excluding cancer of the breast and uterus, males are affected more often than females.

4. At the present time surgery is the only branch of medicine that can cure cancer.

5. The earlier a cancer is operated upon, the better the chance of cure.

6. The medical profession must diagnose cancer earlier, and insist upon early operation.

7. The public must be taught that cancer is a painless disease, and that every delay in submitting to operation lessens the chance of recovery.

BIER'S CONGESTIVE THERAPY *

By E. H. BECKMAN

Professor Bier's congestive treatment of inflammatory conditions, judging from German literature, has an accepted place in that country. The method has been used in the clinic at St. Mary's hospital for some time with good success. After consulting with many physicians of this State, it appears that few of them are familiar with this method of treating disease, and still fewer of them have tried it.

The therapeutic value of general congestion by exercise, massage, baths, and of local congestion by the cautery, drugs, and hot air, have long been known by the profession. Every part of the body becomes congested during its functional activity: Nature's reaction to every injury, whether physical, chemical, or bacterial, is inflammation, or in other words, congestion with its resulting benefits.

The sucking of wounds is one of the oldest methods of treating an injury. Cupping, as formerly practised for the relief of pain (which was once so popular with the profession), is now almost entirely abandoned. Both of these practices have some virtue—they are the means of producing a local hyperemia.

Regarding the treatment of inflammatory conditions by the medical profession during the last two decades, it seems to be fairly well understood that if the process is an acute one, antiphlogistic treatment is demanded (illustrated by the application of ice to an abscess); while, if it is a chronic process, it is proper to produce a congestion or change the process from a chronic to an acute stage

* Read at the meeting of the Southern Minnesota Medical Association, held at Rochester, Minn., August 1, 1907.

(illustrated by curetting and incising a chronic ulcer, or injecting iodoform emulsion into a tuberculous focus).

Paré, as early as 1575, used artificial hyperemia in fractures. From that time down to the present, a few of the profession have used congestion in some form, but always in chronic diseases, and principally in fractures.

Rokitansky's belief that heart lesions producing a congestion of the lungs grant an immunity to tuberculosis, led Professor Bier of Berlin to treat tuberculous joints with artificial passive congestion. The method of treating tuberculous processes by congestion is not a new one, since most observers who use iodoform injections have come to believe that the good resulting from its use is not due to the iodoform alone, but to the fact that the particles are taken up slowly by the leukocytes, and thus produce a local congestion for a considerable length of time.

Professor Bier was the first to use artificial congestive hyperemia in the treatment of acute processes. In considering inflammation, he came to believe that Nature's method of repair is through congestion or hyperemia, and that we should aid Nature by helping to produce congestion. He believes that the present antiphlogistic ideas of treating inflammation are wrong. He first produced congestive hyperemia by using constriction about the part. Klapp, his assistant, in endeavoring to produce congestion in parts where constriction could not be used, began to use suction to produce the congestion, and thus developed a novel method of treating a great variety of conditions. Professor Bier had, however, used this method before, but abandoned it because, having used excessive suction, he failed to obtain satisfactory results.

According to Bier, there are two kinds of congestion: First, arterial or active, produced by him with heated air. Second, venous or passive congestion produced by an elastic bandage about the part, or by cupping. The first method is used principally in the treatment of rheumatic joints.

The second method, with which we wish especially to deal, may be divided into (*a*) hyperemia by suction, and (*b*) hyperemia by constriction. Method (*a*) consists of producing a congestion

by applying a glass vessel to the skin with a bulb or suction pump attached to rarify the air within it. These cups are now on the market made in a variety of shapes and sizes, so as to adjust themselves readily to all surfaces of the body. In some the glass is irregular in shape so as to catch all blood and pus and prevent it from entering the bulb or suction pump. In applying the apparatus two rules should be observed: First, the procedure should not cause pain; second, the suction should be intermittent. Both rules are easily observed. The patient is the best judge as to the amount of suction that should be used. When the patient complains of pain from the suction, it is excessive and a lesser degree should be used. The second rule seems to be equally important. If the suction is *not* intermittent, but little benefit is derived.

One treatment consists in applying the cup with or without greasing the rim, and using suction (painless) for three or four minutes, then removing the cup for one or two minutes. Repeat this process for about half an hour.

Hyperemia by constriction is produced by placing a thin rubber band or bandage about a part, and thus producing a congestion in the portion distal to it. Here, as in the other methods, the process should not be painful.

We have regarded swelling as the cause of pain due to pressure upon the nerve terminals. Bier and Ritter have studied particularly the relation of pain and swelling, and they agree that pain ceases when swelling begins. Ritter regards the irritation of the peripheral nerves by concentrated exudates as the cause of pain. Artificially produced, congestion diminishes this concentration and apparently acts as Schleich's infiltration method of anesthesia. When pain is present artificial congestion should give relief; when absent there should be no discomfort or paresthesia. Much swelling should not be produced, the congested area should not contain dark-red spots, and the parts should never feel cold to the touch.

Professor Bier and his followers, and in fact all who have used this method of treating disease, say that it takes much practice and patience to become precise and skilled in giving the proper

amount of hyperemia. The method deserves commendation for the relief of pain it gives, if for no other reason; but it has been shown experimentally that it is based upon sound principles.

Nötsel injected into passively congested limbs of 67 rabbits fatal doses of anthrax and streptococcus. Seventy per cent. of them lived.

Donato and Delfino made corresponding incision in both ears of rabbits. One ear was constricted and the other left free. The healing in the constricted ear was much more rapid than in the one left free. It has also been shown that by suction over an old discharging sinus, it is possible to raise the opsonic index.

Hamberger says that there is an increase in the alkalies and carbonic acid in both the blood and lymph of the congested part. These both act as bactericides.

Artificial congestive hyperemia has been used for almost every conceivable condition by enthusiastic believers. There are certain conditions where the treatment seems to be especially desirable, and some of these conditions will be mentioned in this paper.

Paronychia and infections about the fingers are treated by placing a rubber band about the base of the fingers for an hour or two at a time three or four times a day. This does not take the place of cleanliness and asepsis, but should be used in conjunction with them. When pus is present it should be evacuated, and then constriction applied. Abscesses and carbuncles and localized inflammatory processes, are treated with splendid success by this method. If seen before suppuration has taken place, it can often be prevented. If suppuration has begun, a small incision is made into the abscess and suction applied. The pus can all be drawn out, fresh blood is drawn to the part, increased leukocytosis is produced, the opsonic index is raised, and the bactericidal power of the blood increased. There is an increase in nutrition, and the power of absorption. Strong antiseptics which destroy granulation tissue and "packs" which dam up the secretions are not needed. In treating abscesses, if the cup does not include the entire inflamed area, failure is almost sure to follow.

Mammary abscesses seem to yield readily to this form of treat-

ment. Klapp has shown that with suction hyperemia the old mutilating radial incision may be abandoned without danger to the patient. With a small incision into the inflamed area, followed by suction, the pus and infectious matter are removed, and an almost painless and rapid cure obtained.

Acute bursitis and synovitis treated by artificial congestive hyperemia give good results. Joints whose function would be lost if treated by free incision and drainage, may often be saved by making a small incision and applying suction and a constriction bandage.

Gonorrheal joints which are usually so painful and difficult to treat, are often relieved in a few hours, and speedily cured by a properly adjusted constricting bandage some distance above the joint.

Bier used artificial congestion first in tuberculous joints and tuberculosis of bone. One of the claims for this method of treatment is, that it stimulates absorption and dissolves adhesions and clots. Any ankylosis of joints, whether tuberculous or not, should be treated by a constriction bandage above the joint for an hour or two, once or twice a day, in combination with passive motion; often astonishingly rapid cures can be affected. Tuberculous processes of bone, fascia, and joints may be incised and drained where necessary, then treated by a properly applied bandage above the affected part. Bier is beginning to use suction over sinuses in these cases in conjunction with a constricting bandage. Chronic non-tuberculous osteomyelitis will often yield to this form of treatment, when repeated operations have failed.

Bier considers the following as contraindications to treatment by hyperemia: Amyloid changes, severe pulmonary tuberculosis, large joint abscesses, and marked malposition of the affected part. Here he advised operation, in all other cases he advises hyperemia, often in conjunction with iodoform injections, in hydrops and purulent joint cases. General systemic infection of any kind is also a contraindication to congestive hyperemia. Where there is edema of a part, artificial congestion should be used with great care, and if the edema is increased after one or two treatments, it should be

abandoned. Some writers have obtained poor results in patients with diabetes.

Bier also uses in certain chronic cases, excessive congestion by applying a tight bandage and leaving it on from ten to twenty-four hours. We have had no experience with this form of hyperemia.

Artificial congestion has been used in the clinic at St. Mary's Hospital with good results in such cases as have been described above. Better results are being obtained, and a wider field of usefulness developed, as we become more familiar with the method and more skilled in its use.

In presenting this brief paper, it is the desire to acquaint the medical profession with this form of treatment, and to arouse interest in it. It is not a "cure-all" or a fad for the specialist, but a rational treatment based upon sound principles, and can be used by every practitioner in his daily work. The more skilled one becomes in its use, the better will be the results. There will be failure in some cases, as there would be in any form of treatment, but it should not be discarded without an honest and intelligent trial.

A form of treatment which has become so universally popular in Germany, and among the few who have used it here, deserves thorough investigation not only by the profession of this State, but by the profession of the entire country.

INDEX OF CONTRIBUTORS

	PAGE
HENRY G. ANDREWS AND LOUIS B. WILSON:	
Stereophotography of Pathologic Specimens: Some Improvements in Technic, and New Apparatus	589
E. H. BECKMAN:	
Bier's Congestive Therapy	628
Diaphragmatic Hernia, with Report of Three Cases	342
Operating-room Technic	581
Plea for the Early Diagnosis and Early Surgical Treatment of Cancer ..	623
W. F. BRAASCH:	
Some Data Acquired with the Aid of the Ureteral Catheter	408
W. F. BRAASCH, WILLIAM J. MAYO, AND WILLIAM C. MACCARTY:	
Relation of Anomalous Renal Blood-vessels to Hydronephrosis	392
H. Z. GIFFIN:	
Some Practical Points in the Physical Examination	617
H. Z. GIFFIN, WILLIAM J. MAYO, AND LOUIS B. WILSON:	
Acquired Diverticulitis of the Large Intestine	294
CHRISTOPHER GRAHAM:	
Cancer of the Stomach	111
Diagnosis of Gastric Ulcer with Differential Diagnosis	169
Differential Diagnosis between Duodenal Ulcer and Gall-stone Disease ..	68
Differential Diagnosis of Diseases Causing Gastric Disturbance	188
Differential Diagnosis of Gall-stones, Ulcer, and Cancer of the Stomach.	179
Gastric Ulcer and Cancer	50
Prominent Symptoms in the Diagnosis of Gastric and Duodenal Ulcers ..	124
CHRISTOPHER GRAHAM AND DONALD GUTHRIE:	
Value of the Test-meal in Gastric Diagnosis	131
DONALD GUTHRIE AND CHRISTOPHER GRAHAM:	
Value of the Test-meal in Gastric Diagnosis	131
DONALD GUTHRIE AND LOUIS B. WILSON:	
Congenital Unilateral Absence of the Urogenital System	385

M. S. HENDERSON:	PAGE
Cyst of the Round Ligament of the Liver.....	228
Retroperitoneal Lipoma.....	348
E. S. JUDD:	
Congenital Idiopathic Dilatation of the Colon: "Hirschsprung's Disease".....	274
Epithelioma of the Lip.....	3
Inguinal Hernia—Types of Operation—Results in 1652 Cases.....	328
Method of Operation for Ununited Fracture.....	553
Transperitoneal Operation for Removal of Bladder Neoplasms.....	375
Treatment of Cancer of the Face, Head, and Neck.....	547
Tumors of the Bladder.....	369
Tumors of the Breast, with Special Reference to Obtaining Better Results in Malignant Cases.....	363
WILLIAM C. MACCARTY:	
Reversion Theory and Classification of Goiter.....	523
WILLIAM C. MACCARTY, WILLIAM J. MAYO, AND W. F. BRAASCH:	
Relation of Anomalous Renal Blood-vessels to Hydronephrosis.....	392
WILLIAM C. MACCARTY AND LOUIS B. WILSON:	
Pathologic Relationships of Gastric Ulcer and Gastric Carcinoma.....	139
ALICE MAGAW:	
Review of Over Fourteen Thousand Surgical Anesthetics.....	567
CHARLES H. MAYO:	
Consideration of the Mortality in One Thousand Operations for Goiter..	498
Goiter: Its Surgical Treatment Based on Four Hundred and Seventy-five Cases.....	441
Goiter, with Preliminary Report of Three Hundred Operations on the Thyroid.....	427
Ligation of the Thyroid Vessels in Certain Cases of Hyperthyroidism..	515
Mortality and Late Results from Thyroidectomy in Exophthalmic Goiter or Hyperthyroidism.....	496
Operative Treatment of Hyperthyroidism.....	508
Parathyroid Question.....	504
Peripheral Versus Intracranial Operations for Tic Douloureux.....	541
President's Address.....	601
Surgical Treatment of Bunion.....	558
Transperitoneal Removal of Tumors of the Bladder.....	355
Treatment of the Posterior Capsule of the Gland in Thyroidectomy, Based on Three Hundred and Seventy-five Operations for Goiter...	419

WILLIAM J. MAYO:

	PAGE
Anemic Spot on the Duodenum, Which May be Mistaken for Ulcer..	203
Chronic Ulcer of the Stomach and Duodenum.....	102
Contributions of Surgery to a Better Understanding of Gastric and Duodenal Ulcer.....	58
Hemorrhage from the Stomach and Duodenum.....	95
Mesocolic or Retrogastric Hernia.....	337
Pancreatitis Resulting from Gall-stone Disease.....	205
Present-day Surgery in England and Scotland; from Notes Made on a Recent Short Visit.....	605
Radical Cure of Umbilical Hernia.....	321
Relation of the Mesocolic Band to Gastro-enterostomy.....	76
Resection for the Relief of Intestinal Obstruction.....	268
Study of Gastric and Duodenal Ulcers, with Especial Reference to Their Surgical Cure.....	81
Surgery of the Large Intestine, with a Review of One Hundred Resections.....	231
Surgical Treatment of Pancreatitis.....	214
Tumors of the Cecum.....	260
Ulcer of the Duodenum, with Report of Two Hundred and Seventy-two Operations.....	194

WILLIAM J. MAYO, W. F. BRAASCH, AND WILLIAM C. MACCARTY:

Relation of Anomalous Renal Blood-vessels to Hydronephrosis.....	392
--	-----

WILLIAM J. MAYO, LOUIS B. WILSON, AND H. Z. GIFFIN:

Acquired Diverticulitis of the Large Intestine.....	294
---	-----

H. S. PLUMMER:

Cardiospasm, with a Report of Cases.....	21
Cardiospasm, with a Report of Forty Cases.....	33
Diverticula of the Esophagus, with a Report of Six Cases.....	11

LOUIS B. WILSON:

Method for the Rapid Preparation of Fresh Tissues for the Microscope..	579
Pathologic Changes in the Thyroid Gland, as Related to the Varying Symptoms in Graves' Disease; Based on the Pathologic Findings in Two Hundred and Ninety-four Cases.....	449
Pathologic Relationships of Exophthalmic and Simple Goiter.....	478
Value of Sondern's Differential Leukocyte Resistance-line in the Diagnosis and Prognosis of Acute Appendicitis.....	280

LOUIS B. WILSON AND HENRY G. ANDREWS:	PAGE
Stereo-photography of Pathologic Specimens: Some Improvements in Technic, and New Apparatus.	589
LOUIS B. WILSON AND DONALD GUTHRIE:	
Congenital Unilateral Absence of the Urogenital System.	385
LOUIS B. WILSON AND WILLIAM C. MACCARTY:	
Pathologic Relationships of Gastric Ulcer and Gastric Carcinoma.	139
LOUIS B. WILSON, WILLIAM J. MAYO, AND H. Z. GIFFIN:	
Acquired Diverticulitis of the Large Intestine.	294

BIBLIOGRAPHIC INDEX

- ABADIE, 438
Abbe, 270, 544, 545
Adami, 147, 241, 348
Albrecht, 293
Andrews, 101, 139, 269, 334, 335, 589
Annandale, 611
- BALFOUR, 337
Barker, 523
Barling, 614
Barry, 625
Bartlett, 586
Basedow, 434, 508
Bashford, 624
Bassini, 335
Bayliss, 524
Beckman, 342, 581, 623, 628
Beebe, 507
Beer, 312, 316
Bell, 313
Bennet, 542
Berchthold, 344
Bergeat, 437
Berkeley, 507
Berry, 233
Bevan, 567
Bier, 553, 628, 629, 630, 632, 633
Billard, 274
Billings, 106
Billroth, 92, 434, 440, 506
Birmingham, 233
Blake, 322
Bloodgood, 336, 436, 437
Bond, 232, 269
Braasch, 386, 392, 394, 403, 408
Brinton, 96
- Bruns, 579, 580
Bull, 437
Butlin, 271, 547
- CABOT, 376, 620
Caldron, 310
Cambridge, 212, 213
Cannon, 36, 65, 66, 270
Championnière, 335
Chavannaz, 316
Cheyne, 615
Chiene, 611
Chlumsky, 309, 317
Christiani, 504, 507
Codman, 198
Coley, 328, 335
Connell, 270, 358
Courvoisier, 221
Crile, 7, 547
Cruveilhier, 96
Cuneo, 366
Cunningham, 235, 612
Cushing, 241, 358, 544
Czerny, 86
- DAUBER, 33
Davis, 224, 369, 375
Dawbarn, 550
Deaver, 285, 293
DeCourmeller, 541
Delfino, 631
Desplat, 542
Dieulafoy, 96, 97
Dolinsky, 524
Donato, 631

- Doyen, 86
 Dudgeon, 268
 Dunham, 25

 EDWARDS, 438
 Einhorn, 33, 41, 42
 Ekehorn, 406, 407
 Eloesser, 213, 226
 Erdmann, 30, 33, 46, 314
 Esmarch, 569
 Ewald, 33
 Ewing, 449, 500

 FAGGE, 95
 Fenger, 393, 407
 Fenwick, 62, 615
 Ferguson, 334, 542
 Finney, 88, 92, 201, 215, 234, 274, 278, 574
 Fitz, 208
 Fleiner, 26, 33, 35
 Flexner, 223
 Fütterer, 62

 GARRÈ, 434
 Generali, 504, 507
 Gibson, 280, 281, 282, 293
 Giffin, 257, 294, 296, 308, 313, 317, 595, 617
 Girard, 334
 Gley, 504, 507
 Gordinier, 309, 317
 Gottstein, 33, 34, 35
 Graham, 50, 68, 96, 111, 124, 131, 169, 179, 188, 310, 311
 Graves, 434, 508
 Greenough, 625
 Grimsdale, 608
 Guthrie, 122, 131, 385, 388

 HALSTED, 3, 7, 480, 507, 515, 523
 Hamberger, 631
 Harrington, 357, 475, 347

 Harris, 356, 381, 507
 Harte, 251
 Hartley, 544
 Heinecke, 84, 394
 Heise, 315
 Helly, 208
 Henderson, 228, 257, 348
 Henoch, 260
 Herter, 268
 Hey, 613
 Hirschsprung, 274
 Hitchings, 547
 Hochenegg, 241, 316, 317
 Horsley, 430, 608, 615, 616
 Howell, 524, 529
 Humphrey, 432
 Hürthle, 430, 504, 507

 JABOULAY, 438, 511
 Jaworski, 173
 Jeandelize, 504, 507
 Jessett, 272
 Johnson, 348
 Jones, 608, 609, 610
 Jonnesco, 235, 438, 511
 Judd, 3, 274, 328, 363, 369, 375, 547, 553

 KEEN, 480
 Keetley, 233
 Kehr, 225
 Kelling, 33, 41, 42, 65
 Kelly, 401
 King, 430
 Klapp, 629, 632
 Kocher, 224, 423, 428, 434, 437, 438, 445, 446, 480, 508, 509, 512, 515, 523, 612
 Kohn, 504, 507
 Kraus, 26, 33, 35, 544
 Krönlein, 239
 Küster, 369

 LACHER, 344
 Lange, 434, 443

- Langenbeck, 407
 LeConte, 251
 Lerche, 33
 Leutzert, 12
 Lichenstein, 33
 Lichtheim, 26
 Lister, 605
 Littlewood, 614
 Lloyd, 614
 Lossen, 33
 Lund, 199
 Lundberg, 504, 507
 Luschka, 33, 35

 MacCALLUM, 500, 505, 507
 MacCarty, 139, 392, 403, 523
 Macewen, 233
 Mackenzie, 436
 Magaw, 567
 Makins, 615
 Martin, 26, 33, 341
 Mastin, 224
 Maunsell, 247, 272
 Mayo (Charles H.), 17, 19, 20, 62, 82,
 139, 194, 205, 222, 355, 375, 395, 419,
 427, 441, 449, 479, 496, 498, 504, 508,
 515, 523, 529, 541, 558, 579, 601
 Mayo (William J.), 22, 58, 76, 81, 95,
 102, 139, 194, 203, 205, 214, 222, 229,
 231, 257, 260, 268, 279, 294, 311, 315,
 321, 337, 345, 351, 387, 388, 392, 395,
 403, 529, 579, 595, 605
 McArthur, 269
 McGaughey, 315
 McGraw, 226
 Mears, 543
 Mellish, 567
 Meltzer, 26, 33, 36
 Merkel, 403, 407
 Mikulicz, 22, 25, 26, 30, 33, 46, 84, 86,
 219, 224, 246, 272, 273, 394, 423, 440,
 506
 Millet, 315
 Mixer, 15
 Möbius, 435, 475, 509
 Monks, 236, 243, 261, 263, 269, 326
 Monprofit, 225
 Morison, 613
 Morris, 395
 Morton, 567
 Moser, 36
 Moullin, 101
 Moussu, 504, 507
 Moynihan, 86, 200, 224, 226, 240, 244,
 253, 614
 Murphy, 273, 542, 562
 Murray, 608

 NETTER, 33
 Nicholson, 434
 Noehren, 280, 293
 Nötsel, 631

 OCHSNER, 326
 Oekonomides, 11
 Opie, 208
 Oppler, 33
 Ord, 436
 Osler, 62

 PARAVICINI, 543
 Pardoe, 615
 Paré, 629
 Parry, 274, 508
 Partia, 506
 Paterson, 615
 Paul, 246, 273
 Pawlow, 66, 206
 Peck, 248
 Pfahler, 549
 Phillips, 208
 Plummer (H. S.), 11, 21, 33, 312, 474
 Plummer (S. C.), 312, 317
 Poirier, 366
 Poncet, 438
 Popielski, 524
 Porta, 440
 Pusey, 549

 QUAIN, 403
 Quénu, 248

- RANDALL, 24
 Rehn, 438
 Reverdin, 428, 438
 Ribbert, 233
 Riedel, 210, 221
 Ritter, 630
 Robinson, 232
 Robson, 210, 211, 213, 219, 221, 224,
 226, 613, 614
 Rodgers, 436
 Rodman, 91, 92, 97
 Rogowitz, 504, 507
 Rokitsansky, 11, 629
 Rose, 543
 Rosenheim, 26, 33, 34
 Roux, 86, 225
 Rumpel, 14, 15, 16, 33, 41, 42
 Russell, 16, 30, 46

 SAMPSON, 309, 311, 317
 Sandström, 442, 504, 507, 509
 Sargent, 268
 Savariaud, 96
 Schrieber, 36
 Scudder, 375
 Sievers, 33
 Sifton, 432
 Simons, 625
 Simpson, 571
 Sippy, 31, 33
 Socin, 440, 506
 Sondern, 280, 293
 Sonnenberg, 543
 Spencer, 579
 Starling, 66, 206, 524
 Stellwag, 435, 509
 Stiles, 274, 328, 611
 Strauss, 14, 15, 16, 33, 45
 Symington, 235

 TAIT, 608, 614
 Taylor, 62
 Teals, 613

 Thoma, 343
 Thomas, 608
 Thompson, 504, 507, 612
 Treves, 235, 243, 269
 Truesdale, 312
 Turner, 613
 Tuttle, 247, 248

 VASSALE, 504, 507
 Virchow, 407
 Voegtlin, 505, 507
 Von Bergmann, 342
 Von Eiselsberg, 86
 Von Graefe, 435, 509
 Von Operchowski, 36
 Von Schmieden, 554
 Von Strümpell, 33
 Von Ziemssen, 25, 33

 WALLACE, 612
 Warren, 366
 Watson, 355, 356, 357, 372, 373, 376
 Weir, 198, 247, 271
 Welch, 62
 Welsh, 504, 507
 White, 97
 Williams, 140
 Wilson, 139, 257, 280, 294, 296, 297, 385,
 388, 449, 478, 500, 508, 527, 535, 579,
 589, 595
 Winiwarter, 224
 Wolff, 438
 Wölfler, 438, 511, 516
 Wood, 280
 Woolsey, 210, 219
 Wyeth, 542

 YOUNG, 232

 ZAUSCH, 33
 Zenker, 12, 25, 33, 35
 Zielenska, 504, 507

INDEX OF SUBJECTS

- ABBE's treatment of tic douloureux, 544**
- Abdomen, examination of, 619, 620**
- Abscess, Bier's hyperemia in, 631**
 in appendicitis, Sondern's resistance-
 line in, 288, 289, 290, 291, 292
 intraperitoneal, 295, 296
 of breast, Bier's hyperemia in, 631
- Achylia, diarrhea of, 104**
- Acidity, diagnostic value, 131**
 ulcer and, 104, 106
- Active hyperemia, 629**
- Adenocarcinoma of cecum, 251**
- Adenoma of bladder, 370, 377**
 of parathyroids, 506
 of thyroid gland, 423, 437, 450, 463
 case, 469, 486, 487, 490
 fetal, 530, 536
 operation for, mortality, 499
 technic, 512
- Adhesions, peritoneal, 79, 80**
- Air embolism from goiter operation, 424**
 injections in tic douloureux, 542
- Alimentary canal, 1**
 sterility of, 241
- Ampulla of Vater, 207**
- Anal canal, 235**
- Anastomosis after resection of cecum, 265**
 end-to-end, 245
 after excision of sigmoid, 255
 after resection for obstruction, 270
 at transverse colon, 272
 Connell suture for, 270
 for cancer of cecum, 266
 Murphy button for, 270
 end-to-side, 245
 for cancer of cecum, 266
- Anastomosis, ileocolic, for obstruction, 271**
 Murphy button in, 271
 intestinal, methods, 245
 intussusception after, 272
 lateral, 245, 246
 after excision of cecum and as-
 cending colon, 251
 of hepatic flexure, 253
 at transverse colon, 272
 for cancer of cecum, 266
 for fecal fistula, 255
 for obstruction of small intestine, 270
 leakage after, 247
 Mikulicz and Paul's, 246
 of rectum with sigmoid, 247
 three-stage, 246
- Andrews-Moullin technic for gastric hemorrhage, 101**
- Anemia, pernicious, gastric cancer and, differentiation, 118, 193**
 contents in, 137
 ulcer and, differentiation, 193
 secondary, diagnosis, 622
 ulcer and, 104
- Anemic spot on duodenum, ulcer and, differentiation, 201, 203**
- Anesthesia, 565**
 chloroform, 573, 583
 air and, 573
 danger-signals in, 574
 in children, 574
 pulse in, 574
 technic, 573
 difficulties of, 574, 575
 ether, 567, 583
 air and, 572

- Anesthesia, ether, chloroform with, 567
 contraindications, 573
 dangers of, 573
 dose of, 570
 drop method, 567
 in colds, 592
 in gall-bladder work, 569
 in gastric operations, 571
 in peritonitis, 572
 in pulmonary tuberculosis, 573
 in Trendelenburg position, 572
 indications for, 571
 nitrous oxid gas preliminary to, 567
 on operating table, 571, 572
 open method, 567
 pneumonia from, 573
 position of patient, 568
 preparation for, 568
 respiration in, 569, 570
 scopolamin and morphin preliminary to, 567
 signs of narcosis, 570
 of returning consciousness, 571
 suggestion in production of, 569
 technic, 569
 for ligation of thyroid vessels, 519
 for thyroidectomy, 503, 513
 in England, 607
 in hyperthyroidism, 573
 on operating table, 571, 582
 review of over 14,000 cases, 567
- Anesthetics, 565, 583
- Angioma of bladder, 370, 377
- Angioneurotic edema, cecal tumor from, 260
- Ankylosis of joints, Bier's hyperemia for, 632
- Annandale's work at Edinburgh, 611
- Apoplexy, pancreatic, 208
- Apparatus for stereo-photography of pathologic specimens, 589, 591
- Appendectomy, deprecation of, 233
- Appendices epiploicæ of large intestine, 241
- Appendicitis, abscess with, Sondern's resistance-line in, 288, 289, 290, 291, 292
- Appendicitis, acute catarrhal, Sondern's resistance-line in, 284, 286
 leukocyte count in, 280
 polynuclear percentage in, 280
 Sondern's differential resistance-line in, 280
 chronic recurring, differential diagnosis, 176, 191
 Sondern's resistance-line in, 286, 287
 diagnosis, 621
 etiology, 233
 gastric ulcer and, differentiation, 176
 hydronephrosis and, differentiation, 398
 inguinal hernia after, 330
 peritonitis in, Sondern's resistance-line in, 289
 purulent, Sondern's resistance-line in, 285, 286
 urinary tests, 622
- Appendix, anatomy of, 233, 236, 261
 carcinoma of, 251
 function of, 233
 obliterative tendency, 233
 removal of, deprecation of, 233
 size of, 233
 tuberculosis of, 257
- Apple-core sensation in ulcer, 127
- Arsenic paste in cancer of face, 548
- Arterial artificial hyperemia, 629
- Artificial hyperemia, 628. See also *Bier's hyperemia*.
- Ascending colon, anatomy of, 236, 261, 262
 benign disease of, resection for, 254
 cancer of, 237, 261
 resection for, 249
 statistics, 258
 mobilization of, 263, 264
 obstruction in, resection for, 271
- Assimilation of food, 102
- Assistants, preparation of, 585
- Atony, cardiospasm and, 33, 34, 35
- Atrophy, pressure, in goiter, 437

- BARTLETT's preparation of catgut, 586**
Basedow's disease, 434, 444. See also
Hyperthyroidism
Bassini's operation for inguinal hernia, 335
Bennet's treatment of tic douloureux, 542
Bier's hyperemia, 628
 active, 629
 arterial, 629
 by constriction, 629, 630
 by suction, 629
 contraindications, 632
 experiments to prove value of, 631
 in abscesses, 631
 in ankylosis, 632
 in bone diseases, 632
 in bursitis, 632
 in carbuncles, 631
 in fractures, 553, 629
 in inflammations, 629
 in osteomyelitis, 632
 in pain, 630
 in paronychia, 631
 in synovitis, 629, 632
 in tuberculous joints, 629, 632
 in ununited fractures, 553
 passive, 629
 uses of, 631
 value of, 631
 venous, 629
Bile-duct, common, anatomy of, 205, 208
 drainage of, after cholecystectomy, 226
Birmingham, surgical work at, 614
Bladder, adenoma of, 370, 377
 angioma of, 370, 377
 cancer of, 357, 358
 cyst of, 370
 dermoid of, 370
 embryologic development of, 391
 fecal fistula into, 295
 fibroma of, 370
 hernia, 333
 in inguinal hernia, 329
 myoma of, 370, 377
Bladder, myxoma of, 370, 377
 papilloma of, 369. See also *Papilloma of bladder.*
 sarcoma of, 370, 377
 tumors of, 369
 benign, 369
 cautery removal, 357, 359
 classification, 369
 cystoscopic examination, 355, 372, 375
 diagnosis, 372, 375
 etiology, 371
 general considerations, 369
 involving whole bladder-wall, 356
 malignant, 369
 operation for, route, 355
 prognosis, 372
 statistics, 383
 suprapubic removal, 356, 378
 symptoms, 371
 transperitoneal removal, 355, 357, 373, 375, 379
 cases, 359
 closure of wound, 358, 393
 Connell suture after, 358, 381
 Cushing suture after, 358, 361
 results, 382
 suture after, 358, 361, 373, 381
 treatment, 372
 ureteral obstruction from, 411
 urethral removal of, 355, 372
 with broad base, 356
 with pedicle, 356
Bloody dysentery, study of, 618
 stools, ulcer and, 95, 96
Bond's reverse mucous currents, 232
Bone diseases, Bier's hyperemia in, 632
 tissue, formation of, 554
Bowels in cholelithiasis, 73
 in duodenal ulcer, 73
Breast abscess, Bier's hyperemia in, 631
 biology of, 523
 cancer of, 363. See also *Cancer of breast.*
 examination of, 621
 lymphatics of, 366, 367

- Breast, stimulation of, 529
 supernumerary, without nipples, 528
 tumor of, 363
 benign and malignant, differential diagnosis, 363
 cancer and, 625, 626
 early removal, 365
 frozen section method, 364
 prognosis, 365
 with reference to bettering results, 363
- Bright's disease, acidity and, 192
 gastric cancer and, differentiation, 118
 disturbances in, 192
- Bruns' glucose medium, 580
- Bunion, characteristic of foot with tendency to, 558
 etiology, 558
 hallux valgus deformity in, 558, 559
 Mayo's technic for, 561
 shoes and, 558, 559
 surgical treatment, 558
- Bursitis, Bier's hyperemic treatment in, 632
- CABOT's method of examining abdomen, 620
- Calculus in ureter, 410
- Callus, development of, 554
- Camera for stereo-photography of specimens, 591, 592
- Cambridge's test in pancreatitis, 212
- Canal, alimentary, 1
 of Jonnesco, 59
- Cancer, cardiospasm and, 35
 diagnosis, early, plea for, 623
 etiology, 624
 gastric. See *Gastric cancer*.
 mortality, 623, 624
 of appendix, 251
 of ascending colon, 237, 261
 resection for, 249
 statistics, 258
 of bladder, 357, 358, 377
 papillary, 370
- Cancer of bladder, prognosis, 372
 radical removal, 378
 scirrhus, 370
 transperitoneal removal, 380
- of breast, 363
 age and, 366
 convalescence, 367
 lymphatic involvement, 366
 pathologist's report, 364
 prognosis, 365
 surgical treatment, results, 625
- of cecum, 236, 261. See also *Cecum, cancer of*.
 of colon, resection for, 249
 of costocolic ligament, 253
 of descending colon, 249, 253
 of face, 547, 548
 arsenic paste in, 548
 death from, 547
 excision in, 549
 x-ray in, 549
 of head, 547, 549
 death from, 547
 ligation of carotids in, 550
 of hepatic flexure, 252
 resection for, statistics, 258
 of intestine, embolic carcinoma of liver and, 240
 of large intestine, removal of, 245
 of larynx, 551
 of lip, 3, 549, 626. See also *Epithelioma of lip*.
 of liver, embolic, intestinal cancer and, 240
 of mouth, 549
 of neck, 547, 550
 cervical lymphatics and, 551
 death from, 547
 of pharynx, 551
 of sigmoid, 253
 resection for, statistics, 259
 of splenic flexure, 252
 resection for, statistics, 258
 of stomach, 111. See also *Gastric cancer*.
 of thyroid gland, 437, 448, 502, 551
 of tongue, 549, 551

- Cancer of transverse colon, 249, 252
 resection for, statistics, 258
 of uterus, early treatment, 626
 painlessness of, 626
 sex and, 623
 spread of, 623, 624
 surgical treatment, 625
 early, plea for, 623
 treatment of, 623, 624
- Carbuncles, Bier's hyperemia in, 631
- Carcinoma. See *Cancer*.
- Cardia, cocain painting of, before
 esophagotomy, 45
 fissure at, cardiospasm and, 45, 48
- Cardiospasm, 21, 33
 anlage and, 35, 47
 atony and, 33, 34, 35
 carcinoma and, 35
 cases, 21, 33
 congenital disposition theory, 35
 deglutition in, 36
 development of, 37
 diagnosis, 28, 41
 dilatation in, 21, 22, 25, 30, 46
 dilator for, 31, 30, 40
 early symptoms, 27
 esophageal dilatation and, 25, 26, 29,
 34, 38
 esophagitis in, 27, 35
 esophagoscopy in, 45
 fissure and, 45, 48
 gastric contents in, 42
 gastrostomy in, 21, 30, 45, 46
 gastrotomy for, 22, 30, 45, 46
 Kraus' theory, 35
 long-standing, 49
 Mikulicz's technic, 30, 46
 nutrition in, 41
 passage of food in, 36
 Plummer's sound in, 44
 radiography in, 29, 43
 Russell's rubber balloon for, 31, 46
 silk thread method of diagnosing, 42
 stages of, 37
 stomach-tube in, 41, 42
 Strauss' volume-measure after, 45
 symptom-complex, 38
- Cardiospasm, symptoms, 27, 38
 tabulated report of forty cases, 48, 49
 test meal in, 41
 treatment, 30, 45
 with esophageal dilatation, 34, 38
 with regurgitation, immediate, 37, 38
 without regurgitation, 37, 38
- Cast-like appearance of stereo-photographs, 593
- Catarrhal jaundice from pancreatic disturbance, 208
- Catgut, 586
 preparation of, 586
- Catharsis before operation, 241
- Catheter, ureteral, 408. See also *Catheterization*.
- Catheterization, data acquired from, 408
 in hydronephrosis, 400
 length of catheter, 408
 obstruction to passage of catheter, 409
- Cautery removal of papilla of bladder, 357, 359
- Cecum, adenocarcinoma of, 251
 anatomy of, 236, 261
 benign disease of, resection for, 254
 cancer of, 236, 261
 involvement of adjacent parts, 263
 operation for, 263
 resection for, 249, 263
 statistics, 258, 267
 inflammation of, resection for, 254
 mobilization of, 263, 264
 resection of, anastomosis after, 265
 incision for, 263
 sarcoma of, 267
 tuberculosis of, 260
 tumors of, 260
 benign, 260
 from angioneurotic edema, 260
 obstruction and, 262
 symptoms, 262, 263
- Cells of Leydig, 217
- Cervical lymphatic glands, cancer and, 551
- Chalmers Hospital, Edinburgh, 612
- Chiene's work at Edinburgh, 611

- Children's Hospital of Edinburgh, 611
- Chloroform and ether anesthesia, 567
anesthesia, 573. See also *Anesthesia, chloroform*.
- Cholecystoduodenostomy for gallstones with pancreatitis, 213
- Cholecystectomy, drainage of common duct after, 226
in cholelithiasis, 222
- Cholecystenterostomy for gallstones with pancreatitis, 213
in pancreatitis, 222, 224
McGraw ligature in, 226
Monprofit's, 225
Murphy button in, 226
suture for, 226
- Cholecystostomy for gallstones with pancreatitis, 213
in pancreatitis, 222
- Cholelithiasis, bowels in, 73
cholecystectomy in, 222
constipation in, 73
differential diagnosis, 179, 190
summary, 185
duodenal ulcer and, conclusion, 74
differentiation, 68
gas in, 69, 70
gastric contents in, 74
hemorrhage in, 72
hydronephrosis and, differentiation, 398
jaundice in, 72
nutrition in, loss of, 73
pain in, 69
pancreatitis from, 205. See also *Pancreatitis from cholelithiasis*.
surgical treatment, 212
symptoms, 69
vomiting in, 71
- Cigarette drain, 587
- Clado's ligament, 236
- Cocain painting before esophagoscopy, 45
- Coffee-ground stomach contents, 96
- Colds, anesthesia in, 572
- Colectomy for colitis, chronic ulcerative, 254
- Coley's operation for inguinal hernia, 335
- Colic artery, left, 239
middle, 238
right, 237
renal, artificial, 401
- Colitis, chronic ulcerative, colectomy for, 254
resection for, 254
- Collar incision in epithelioma of lip, 4, 8
in goiter, 423, 439, 446
in thyroidectomy, 512
- Colloid, 530
adenoma of thyroid, 450, 463
goiter, 427, 437, 450, 461
operation for, mortality, 499
pathology of, case, 488
- Colon and gall-bladder, union between, 225
ascending, anatomy of, 236, 261, 262
benign disease of, resection for, 254
cancer of, 237
resection for, 249
statistics, 258
mobilization of, 263, 264
obstruction in, resection for, 271
descending, anatomy of, 236
cancer of, 249, 253
resection of, for obstruction, 272
diverticulitis of, 294. See also *Diverticulitis of large intestine*.
giant, 257, 274. See also *Hirschsprung's disease*.
head of, 234
hepatic flexure of, 239
lymph drainage of, 239
separating of, 244
splenic flexure of, anatomy of, 239
transverse, anatomy of, 236
benign disease of, resection for, 257
cancer of, 249, 252
resection for, statistics, 258
obstruction at, resection for, 272
- Colostomy, preliminary to resection, 249

- Common bile duct, anatomy of, 205, 208
 drainage of, after cholecystectomy, 226
 carotids, ligation of, in hydrocephalus in infants, 611
 tic douloureux, 542
- Congenital disposition theory of cardiospasm, 35
- Congestive therapy, Bier's, 628. See also *Bier's hyperemia*.
- Connell suture after transperitoneal removal of bladder tumor, 381
 for anastomosis, 270
 of bladder, 358
- Constipation in cholelithiasis, 73
 in duodenal ulcer, 73
 in etiology of diverticulitis, 309
 in Hirschsprung's disease, 275
 narrow ileocecal orifice and, 234
- Constriction hyperemia, 629, 630
- Contact ulcer, 105, 195
- Cooper Hewitt mercury-vapor light for stereo-photography of pathologic specimens, 590
- Costocolic ligament, 239
 cancer of, 253
- Courvoisier's law, 221
- Cretenism, 526
 thyroid feeding in, 443
- Cunningham as director of anatomic laboratories in Edinburgh, 612
- Cupping, 628
- Cushing suture after removal of bladder tumor, 358, 361
- Cystoscopic examination for tumors, 355, 372, 375
 for hydronephrosis, 400
- Cysts of bladder, 370
 cystoscopic examinations in, 355, 372, 375
 of parathyroids, 506
 of round ligament of liver, 228, 423, 437
 of thyroid gland, 423, 437, 448
 cases, 489
 operation for, mortality, 499
- Cysts, pancreatic, hydronephrosis and, differentiation, 399
- Cytolysis in goiter, 533
- DEACONESSES Hospital of Edinburgh, 612
- Defecation, mechanics of, 235
- Deglutition, 36
 in cardiospasm, 36
- Dermoid of bladder, 370
- Descending colon, anatomy of, 236
 cancer of, 249, 253
 resection of, for obstruction, 272
- Desplat's treatment of tic douloureux, 542
- Diaphragm, derivation of, 342
- Diaphragmatic hernia, 342. See also *Hernia, diaphragmatic*.
- Diarrhea of achylia, 104
 study of, 618
- Dieulafoy's mucous erosion, 96
- Differential resistance-line, Sondern's, in appendicitis, 280
- Digestion, 102, 103
 in large intestine, 231
 process of, 231
- Digestive system, nervous control of, 66
- Dilatation in cardiospasm, 21, 22, 25, 30, 46
 in gastric cancer, 54
 of colon, congenital idiopathic, 257, 274. See also *Hirschsprung's disease*.
 of esophagus, cardiospasm and, 25, 26, 29, 34, 38
 idiopathic, 25, 33
 of pelvis of kidney, 413
 of ureter, cystic, 411
- Dilator, esophageal, 39, 40
 for cardiospasm, 31
- Diverticula, Meckel's, 232
 of esophagus, 11
 anatomic classification, 12
 at middle third, 12
 cases, 17-20
 classification, 11

- Diverticula of esophagus, deep-seated,**
 12
 esophagoscope in, 17
 objective examination, 14
 pharyngo-esophageal, 12
 Plummer's silk thread method in,
 15
 pressure, 11, 12
 pulsion, 11, 12
 Rumpel's sound for, 14, 15
 silk thread method in, 15
 skiagraphy in, 14
 Strauss' volume-measure in, 14, 16
 symptoms, 12
 traction, 11
 traction-pressure, 11
 Zenker's, 12
 pharyngeal, 12
 pharyngo-esophageal, 12
 cases, 17-20
 diagnosis, 13
- Diverticulitis, 257, 260**
 of large intestine, acquired, 294
 acute ulcerative, 305
 chronic, 306
 classification, 316
 clinical course, 308
 diagnosis, 316
 differential diagnosis, 313, 316,
 317
 etiology, 309
 false, 308
 inflammatory deposits in, 303
 pain in, 310, 311
 pathology, 297
 probable cases, 313-315
 site of, 309
 surgical treatment, 296
 true, 308
 resection for, 257
 use of term, 307
- Drainage after gall-bladder operation,**
 587, 588
 dressings, 586
- Drainage-tubes, 587**
- Drawings and photographs, relative**
 value, 595
- Dressings, 585, 586**
 drainage, 586
 sterilization of, 585
- Drop method of ether anesthesia, 567**
- Drowning, fecal, during resection for**
 obstruction, 269
 from regurgitation of intestinal con-
 tent, 243
- Duct of Santorini, 207**
 of Wirsung, 207
- Ductless glands, 417**
- Duodenal cancer, ulcer and, 62, 85, 199,**
 200
 hemorrhage, 95
 cancer and, 96
 gastrojejunostomy for, 99
 surgical treatment, 99
 ulcer, 81, 194
 acid juices in etiology, 198
 acidity and, 104, 106
 anemia and, 104
 anemic spot and, differentiation,
 201, 203
 bleeding, 96
 blood examination in, 108
 bloody stools in, 107
 bowels in, 73
 calloused, 58
 cancer and, 82, 85, 199, 200
 chronic, 102
 pathology, 86
 prognosis, 105
 surgical treatment, development
 of, 83
 without evidence, 93
 classification, 58
 constipation in, 73
 contributions of surgery to better
 understanding, 58
 cure of, 202
 diagnosis, 105, 169
 prominent symptoms in, 124
 differential diagnosis, 130, 188
 excision of, 200
 union with stomach and, 200, 201
 factors in causation, 104
 food-ease in, 106, 199

- Duodenal ulcer, frequency of, 61, 194
 - gall-stones and, conclusion, 74
 - differentiation, 68
 - gas in, 71, 108
 - gastric contents in, 74, 192, 135
 - ulcer and, differentiation, 110, 124, 195, 199
 - relative frequency, 59
 - gastrojejunostomy for, 84, 200
 - hemorrhage in, 72, 95, 107
 - surgical treatment, 100
 - hunger pain in, 106, 199
 - hydrochloric acid and, 104, 106, 132
 - indurated, 58, 59, 60, 61
 - jaundice in, 72
 - location, 59, 60, 105
 - mechanics in causation, 196
 - multiple, 195
 - nausea in, 108
 - no-loop operation for, 200
 - non-indurated mucous, 58, 63
 - nutrition in, loss of, 73
 - obstruction by, 109
 - pain in, 70, 106, 126
 - location of ulcer, by 127
 - relief from food, 128
 - perforation in, 108, 129, 198
 - cases operated on for, 83
 - surgical production, 199
 - periodicity of attacks, 124, 199
 - peritonitis in, 108
 - pyloroplasty for, 84
 - report of 272 operations, 194
 - sex and, 61, 196
 - site of, 60, 195, 197
 - surgical cures, 81, 93
 - indications, 110
 - symptomatology, 69
 - symptoms, control, 129
 - length of time they have persisted, 126
 - prominent, 124
 - traumatism and, 104
 - treatment, 110, 200
 - tumor in, 109
 - urine, 108
 - vomiting in, 71, 108
- Duodenohepatic ligament, 239
- Duodenum, anatomy of, 196, 197
 - and gall-bladder, union between, 224
 - anemic spot on, ulcer and, differentiation, 201, 203
 - blood-vessels of, 196, 201
 - development of, 197
 - diseases of, cases operated on from 1893 to 1909, 82
 - embryologic origin, 102
 - hemorrhage from, 95
 - hour-glass, 201
 - identification of, 244, 264
 - messenger from, 524
- Dysentery, bloody, study of, 618
- ECONOMY in operating room, 581
- Edema, angioneurotic, cecal tumor from, 260
- Edinburgh, surgical work at, 610
- Elbow fracture, Jones' treatment, 609, 610
- Embolism, air, from goiter operation, 424
- End-to-end anastomosis, 245
 - after excision of sigmoid, 255
 - after resection for obstruction, 270
 - at transverse colon, 272
 - Connell suture for, 270
 - for cancer of cecum, 266
 - Murphy button for, 270
- End-to-side anastomosis, 245
 - for cancer of cecum, 266
- England, hospitals of, 606
- Entero-anastomosis with gastrojejunostomy, 86
- Enterostomy preliminary to resection, 249
- Epithelial glands, biology of, 523
- Epithelioma of lip, 3, 549
 - avoidance of hypoglossal nerve in operating for, 9
 - diagnosis, 3, 4

- Epithelioma of lip, drainage after excision, 9
 early treatment, 626
 extension, 6
 glandular involvement, 3, 4, 6
 growth, 6
 incision in, 4, 8, 9
 removal of glands, 6, 7
 report of cases, 7
 squamous-celled, 5
 technic, 8
- Erosion of stomach, mucous, 96, 97
- Esmarch ether inhaler, 569
- Esophageal sound, Plummer's, 44
- Esophagitis, cardiospasm and, 27, 35
- Esophagoscope in diverticula, 17
- Esophagoscopy, cocaine painting of cardia before, 45
 in cardiospasm, 45
- Esophagus, cardiospastic dilatation of, 13
 dilatation of, cardiospasm and, 25, 26, 29, 34, 38
 idiopathic, 25, 33
 dilator for, 39, 40
 diverticula of, 11. See also *Diverticula of esophagus*.
 injury to, during goiter operation, 424
 Lanier-Hackermann point of, 12
 motor disturbances, classification, 34
- Ether anesthesia, 567. See also *Anesthesia, ether*.
- Eventratio diaphragmatica, 343
- Examination of abdomen, 619, 620
 of breasts, 621
 pelvic, in girls, 619
 in man, 619
 physical, practical points in, 617
 purging before, 620
 rectal, 617, 619
 vaginal, in girls, 619
- Excision of pylorus with gastrojejunostomy, 91, 92
- Exophthalmic goiter. See *Hyperthyroidism*.
- Exothyropepy, 438
- Extremities. 538
- FACE, cancer of, 547. See also *Cancer of face*.
 rodent ulcer of, 548
- Facial neuralgia, 541. See also *Tic douloureux*.
- Facies in gastric ulcer, 112
- Fat necrosis in pancreatitis, 208, 220
- Fecal drowning during resection for obstruction, 269
 fistula, anastomosis for, 255
 into bladder, 294
- Fenestrated sound of Rumpel in diverticula of esophagus, 14, 15
- Ferguson's treatment of tic douloureux, 542
- Fetal thyroid, 529
- Fetus, peritoneal cavity in, 80
- Fibrolipoma of sigmoid, 257
 of transverse colon, resection for, 257
 retroperitoneal, 349
- Fibroma of bladder, 370
- Fibromyoma, intussusception from, 256
- Field of operation, preparation of, 584
- Finney's gastrojejunostomy, 88, 92
- First portion of rectum, 235, 240
- Fissure at cardia, 45, 48
- Fistula, fecal, anastomosis for, 255
 into bladder, 294
- Food, digestion of, 102, 103
 maceration of, 103
 propulsion of, into stomach, from dilated esophagus, 36
 storage of, in stomach, 102, 103
 where assimilated, 102
- Food-ease in ulcer, 106, 199
- Foramen Bochdaleki, 343
 Morgagni, 343
- Foregut, derivatives of, 65
- Fossæ in connection with large intestine, 240
- Fractures, congestive treatment, 629
 of elbow, Jones' treatment, 609, 610
 ununited, Bier's hyperemia in, 553
 course, 553, 554
 operation for, 553
 cases, 555-557
 osteomyelitis in treatment of, 554

- Fractures, ununited, Von Schmieden's treatment, 554
- Fresh tissues, rapid preparation of, for microscope, 579
- GALL-BLADDER and colon, union between, 225
- and duodenum, union between, 224
- and jejunum, union between, 224
- and stomach, union between, 225
- contracted, in pancreatitis, 221
- diseases, differential diagnosis, 190
- gastric cancer and, differentiation, 119
- drain for, 587, 588
- function of, 223
- operations, ether anesthesia and, 569
- Gall-stone disease. See *Cholelithiasis*.
- Garroto's capsule, 236
- Gas in cholelithiasis, 69, 70
- in duodenal ulcer, 71
- Gasserian ganglion, intracranial removal of, 544
- peripheral removal of, 543
- removal of, in tic douloureux, 543
- Gastric cancer, 111
- appetite in, 55
- Bright's disease and, differentiation, 118
- cardiospasm and, 35
- coffee-ground stomach-contents and, 96
- diagnosis, early, 121
- differential diagnosis, 117, 182, 185, 189
- dilatation in, 54
- face in, 112
- gall-bladder disease and, differentiation, 119
- gas in, 185
- hemorrhage in, 96
- hour-glass stomach and, differentiation, 119
- hydrochloric acid secretion in, 132
- pain in, 115, 183, 189
- paralysis of, 116
- Gastric cancer, pathology, 56
- pernicious anemia and, 118
- differentiation, 193
- precancerous state in, 113
- pyrosis in, 189
- ring, 162
- stages of, 113
- statistics, 122
- stomach contents in, 136
- surgical treatment, 120
- symptoms, 112
- syphilis and, differentiation, 117
- test-meal in, 185
- treatment, 120
- results, 121
- tuberculosis and, differentiation, 118
- types, 113
- ulcer and, 50, 62, 85, 111, 174, 183, 627
- differentiation, 115, 116, 119, 120, 174
- pathologic relationship, 139
- vomiting in, 54, 56, 115, 116, 184, 189
- contents, examination of, 134
- hydrochloric acid in, diagnostic value, 131
- in cancer, 136
- in cardiospasm, 42
- in cholelithiasis, 74
- in duodenal ulcer, 74
- in functional neurosis, 137
- in pernicious anemia, 137
- in pyloric spasm, 137
- in ulcer, 107, 132, 135
- value of, 131
- crises, value of, 621
- diagnosis, test-meal in, value of, 131
- disease, motor power and, 133
- disturbance, diseases causing, differential diagnosis, 188
- hemorrhage, 95
- Andrews-Moullin operation, 101
- cancer and, 96
- from chronic ulcer, 97
- gastrojejunostomy for, 99

- Gastric hemorrhage in young women, 97
 surgical treatment, 99
 ulcer and, 95
 inflation, 134
 operations, ether anesthesia in, 571
 preparation of patient, 584
 syphilis, differential diagnosis, 192
 ulcer, 81
 acid juices in etiology, 198
 acidity and, 104, 106
 anemia and, 104
 appendicitis and, differentiation, 176
 bleeding, 96
 excision of, 100
 blood examination in, 108
 bloody stools in, 107
 calloused, 58, 91, 92
 cancer and, 50, 53, 62, 85, 111, 174, 183, 627
 differentiation, 115, 116, 119, 120, 174
 pathologic relationship, 139
 cancerous stage, 54
 cardiac, symptoms, 172
 chronic, 102
 hemorrhage from, 97
 pathology, 86
 prognosis, 105
 surgical treatment, development of, 83
 without evidence, 93
 chronicity of, 169
 cicatrical formations in, 173
 classification, 58
 closure of excision defect to enlarge lumen, 99
 complications, 172
 contact, 105, 195
 contributions of surgery to better understanding of, 58
 Cruveilhier's, 96
 diagnosis, 105, 169
 prominent symptoms in, 124
 Dieulafoy's, 96
 differential diagnosis, 130, 169, 174, 180, 185, 188
- Gastric ulcer, duodenal ulcer and, differentiation, 110, 124, 195, 199
 relative frequency, 59
 excision of, 85
 factors in causation, 104
 Finney's operation for, 88, 92
 first stage, 52
 food-ease in, 106, 128
 fourth stage, 54
 frequency of, 61, 194
 gas in, 108, 170
 gastrojejunostomy for, 84, 100
 Heinecke-Mikulicz pyloroplasty in, 84
 hemorrhage and, 95, 107, 174
 hour-glass stomach in, 173
 hydrochloric acid and, 51, 104, 106
 secretion in, 51, 132
 hyperchlorhydria and, 51, 132
 indurated, 58, 59, 61
 latent type, 51
 location of, 59, 104, 105
 medical, 59
 multiple, 195
 nausea in, 108
 non-indurated mucous, 58, 63
 obstruction in, 109, 173
 pain in, 106, 126, 170
 location of ulcer by, 127
 relief from food, 106, 128
 pathology, 56
 peptic, 96
 perforation in, 108, 129, 198
 cases operated on for, 83
 diagnosis, 172
 surgical production, 199
 periodicity of attacks, 124, 169
 peritonitis in, 108
 pernicious anemia and, differentiation, 193
 pyloric spasm and, 64
 pyloroplasty for, 84
 round peptic, 96
 saddle, 89, 98
 cancer and, differentiation, 119
 second stage, 52

- Gastric ulcer, sex and, 61
 situation of, 197
 stages, 51, 52
 stomach contents in, 107, 132, 135
 surgical cures, 81, 93
 indications, 110
 symptoms, 129, 169, 170
 control of, 129
 length of time they have per-
 sisted, 126
 prominent, 124
 test-meals in, 133
 third stage, 52
 traumatism and, 104
 tumor in, 109
 types, 51
 urine in, 108
 vomiting in, 54, 56, 108, 170
- Gastro-enterostomy, mesocolic band
 and, relation, 76, 79
- Gastrojejunostomy, anterior and pos-
 terior, 76, 86
 entero-anastomosis with, 86
 Finney's, 88, 92
 for duodenal ulcer, 84, 200
 for gastric ulcer, 84
 for perforation, 83
 for ulcer, 100
 Mikulicz, 86
 Murphy button in, 84
 no-loop, 76, 86
 for duodenal ulcer, 200
 for hemorrhage, 100
 posterior and anterior, 76, 86
 Rodman's excision of pylorus with, 91
- Gastrostaxis, 97
- Gastrostomy in cardiospasm, 21, 30, 45
- Gastrotomy for cardiospasm, 22, 30, 45
- General papers, 599
- Genitalia, thyroid gland and, connec-
 tion, 443
- Genito-urinary organs, 353
 unilateral absence of, 385
 clinical report, 385
 pathology, 388
- Giant colon, 257, 274. See also
Hirschsprung's disease.
- Gibson's leukocyte chart, 281
 Wilson's modification, 282, 283
- Glands, biology of, 523
 ductless, 417
 stimulation of, 528, 529
 submaxillary, 6
 submental, 6
- Glandular involvement in epithelioma
 of lip, 3, 4, 6
- Gloves, sterilization of, 585
- Glucose medium, Bruns', 580
- Glycosuria in pancreatitis, 211
- Goiter, 427, 443
 anesthesia in, 446
 at puberty, 443
 circumscribed, 421
 classification, 421, 523, 529
 clinical picture, 526
 colloid, 437, 443, 450, 461, 527
 operation for, mortality, 499
 pathology of, case, 488
 cured stage, histology of, 533
 cystic, 535
 histology of, 531, 536
 diffuse, 421
 pathology of, case, 487
 distribution, 428
 during pregnancy, 434, 437, 443
 encapsulated, cases, 489
 etiology, 428, 443
 exophthalmic, 434. See also *Hyper-
 thyroidism.*
 exothyropexy for, 438
 follicular, 444
 hypertrophic, 480
 histology of, 531
 hypertrophic, 480, 536
 Jaboulay's treatment, 438
 Kocher transverse-collar incision²for,
 423, 439, 446, 512
 myxedema in, 534
 open displacement for, 438
 pathologic technic, 450
 pathology of, 478
 cases, 487
 pressure atrophy in, 437
 pulsating, 445

- Goiter, reversion theory of, 523, 525, 528
 secondary changes in, cases, 488
 semi-surgical treatment, 438
 stages of, 527, 529
 surgical treatment, 422, 427, 441, 444
 after-care, 447, 503
 air embolism from, 424
 anesthesia in, 422, 439, 446, 503
 cardiac complications, 446
 contraindications, 446
 diminishing of remaining half of gland after, 438
 esophageal injury during, 424
 Harrington's solution in, 447
 hemorrhage in, 425, 447
 mortality, 502
 Kocher transverse-collar incision for, 423, 439, 446, 512
 Mikulicz's method, 423, 440
 mortality, 448, 498
 myxedema after, 425, 434
 posterior capsule and, 447, 419
 preparation of patient, 584
 statistics, 444, 445
 technic, 439, 446
 tetany after, 420, 425, 506
 tracheal injury during, 424
 toxin production in, 526
 types of, 445, 483, 527, 529
 voice loss in, 437
 x-ray in, 446
- Gonorrheal synovitis, Bier's hyperemia in, 632
- Graves' disease, 434, 444. See also *Hyperthyroidism*.
- Gustatory nerve, removal of, in tic douloureux, 545
- HALLUX valgus in bunion, 558, 559
 operations for, 559
- Harrington's solution, 447, 584
 in goiter operation, 447
- Head, 538
 cancer of, 547. See also *Cancer of head*.
- Heart in hyperthyroidism, 446, 509
- Heinecke-Mikulicz pyloroplasty in ulcer, 84
 technic in hydronephrosis with anomalous renal blood-vessels, 394
- Hematuria in bladder tumors, 371
- Hemorrhage from goiter operation, 425, 447, 502
 from parathyroids, 505, 506
 in cholelithiasis, 72
 in duodenal ulcer, 72, 95, 107. See also *Duodenal hemorrhage*.
 in gastric ulcer, 95, 107, 174. See also *Gastric hemorrhage*.
 in intestinal wall, 260
- Hepatic flexure, 239
 cancer of, 252
 resection for, statistics, 258
 obstruction at, resection for, 271
- Hernia, 319
 bladder, 333
 diaphragmatic, 342
 acquired, 343
 cases, 345
 congenital, 342
 diagnosis, 343
 symptoms, 343
 thoracotomy in, 344
 treatment, 344
 inguinal, 328
 after appendicitis, 330
 Bassini's operation for, 335
 Coley's operation for, 335
 congenital, 329
 containing bladder, 329
 direct, 328
 external, 328
 imbrication for, 334
 interparietal, 329
 oblique, 328
 operations for, 328
 mortality, 331
 results, 328
 technic, 333
 recurrences, 329, 331
 sliding, 329
 statistics, 328

- Hernia, inguinal, transplanting of cord,**
 332, 333, 335
 varieties, 328
 intra-abdominal, 337
 mesocolic, 337
 retrogastric, 337
 Stiles' treatment, 611
 umbilical, 321
 Mayo's operation for, 321, 322
 Ochsner's modification, 326
 overlapping operation, 321, 322
 radical cure of, 321
- Hindgut, derivatives of,** 232
- Hirschsprung's disease, case,** 278
 constipation in, 275
 etiology, 274
 operation for, 279
 pathology of, 277, 278
 resection for, 257, 274
 symptoms, 275
- Histologic technic,** 579
- Hormones, digestive,** 66
- Horsehair suture material,** 586
- Horsley's work in London,** 615
- Hospitals of Edinburgh,** 610
 of England, 606
 of Liverpool, 608
- Hour-glass duodenum,** 201
 stomach, 90, 92, 173
 cancer and, differentiation, 119
 excision in, 100
- Hunger pain in duodenal ulcer,** 106, 199
 in gastric ulcer, 106, 128
- Hydrocephalus in infants, Stiles' treat-
 ment,** 611
- Hydrochloric acid in gastric contents,
 diagnostic value,** 131
 ulcer and, 104, 106
- Hydronephrosis, acquired,** 395
 anomalous renal blood-vessels and,
 392, 403
 clinical considerations, 394
 frequency, 395
 Heinecke - Mikulicz technic,
 394
 surgical considerations, 392
 appendicitis and, differentiation, 398
- Hydronephrosis, catheterization in,** 400
 cholelithiasis and, differentiation, 398
 congenital, 394
 cystoscopic examination in, 400
 diagnostic data, 396
 differential diagnosis, 398
 frequency, 395
 gastric symptoms, 398
 nephrolithiasis and, differentiation,
 398
 ovarian cysts and, differentiation, 399
 pancreatic cysts and, differentiation,
 399
 pelvic distention in, 401
 phloridzin test in, 399
 symptoms, 396
 urinary data, 399, 411
 valve formation in, 393
 x-ray diagnosis, 397
- Hyperchlorhydria, diagnostic value,
 131
 ulcer and,** 51
- Hyperemia, Bier's,** 628. See also *Bier's
 hyperemia.*
- Hyperkinetic esophageal disturbances,
 34**
- Hyperthyroidism, 432, 442, 444
 age and,** 510
 anesthesia in, 439, 446, 503, 513, 573
 at puberty, 436
 cases, 460
 circulatory symptoms, 510
 clinical grouping of cases, 474
 value of pathologic data, 474, 476
 development of, 476
 division of isthmus in, 438
 during pregnancy, 437
 etiology, 523
 exophthalmos in, 509, 535, 536
 eye symptoms in, 509
 features of, 508
 first series, 460-469
 gastric symptoms, 509
 gland in, 509
 goiter and, pathologic relationships,
 478
 heart in, 509

- Hyperthyroidism, histology of, 532, 535, 536**
 hygienic treatment, 436
 hypertrophy in, 480
 incision for, 423, 439, 446
 intestinal symptoms, 509
 ligation of blood-vessels in, 438, 511, 512, 515
 after-treatment, 520
 anesthetic for, 519
 gland changes after, 520
 indications, 517, 518
 mortality, 501
 results, 521
 technic, 519
 Mikulicz's method for, 440
 Möbius' sign in, 435
 theory, 475
 muscular symptoms, 509
 myxedema in, 512
 operation for, 438, 444, 446, 508, 511, 515
 after-treatment, 513
 graduated, 511
 statistics, 444, 445
 technic, 439, 446, 512
 pathologic deductions, 475
 grouping of cases, 449
 technic, 450
 pathology, 435, 449
 cases, 483
 relation to symptoms, 449, 478
 pulsating, 445
 relief of, 438
 reversion theory, 523, 525, 526, 528
 second series, 469-473
 secondary to preëxisting goiter, 445
 serum therapy in, 436, 444
 sex and, 510
 skin changes in, 510
 Stellwag's sign in, 435
 sympathectomy for, 438
 symptoms, 434, 509
 tachycardia in, 509
 therapeutic treatment, 436
 thyroid changes in, 449, 474
 thyroidectomy for, 511, 512
- Hyperthyroidism, thyroidectomy for,**
 after-care, 503
 late results, 496
 mortality, 496, 498, 499
 treatment, 436, 444
 tremor in, 509
 typical, 449, 460
 unilateral, 510
 thyroidectomy for, 512
 usual type, 445
 von Graefe's symptom in, 435
 with colloid, 450, 461
 with parenchyma increase, 469
 with total improvement, 464
 without goiter, 509
 x-ray in, 436
- Hypertrophy, compensatory, in goiter, 480**
 Hypoglossal nerve, avoidance of, in operating for epithelioma of lip, 9
 Hypothyroidism, 433, 434, 442
- ICTERUS. See Jaundice.**
 Ileocecum, obstruction at, resection for, 271
 tuberculosis of, 256
 Ileocolic anastomosis for obstruction, 271
 Murphy button in, 271
 Ileocolostomy, 245, 266
 Ileum, anatomy of, 236
 Imbrication for inguinal hernia, 334
 Incision for cecal resection, 263
 for epithelioma of lip, 9
 for ligation of thyroid vessels, 519
 for resection of large intestine, 243
 in epithelioma of lip, 4, 8
 Kocher transverse-collar, in goiter, 423, 439, 446, 512
 Inflammatory conditions, Bier's hyperemia in, 629
 treatment, 628
 Inflation of stomach, 134
 Inguinal hernia, 328. See *Hernia, inguinal.*
 Inhaler, Esmarch, 569

- Instruments, sterilization of, 585
 Internal secretion, 214, 527
 International Congress on Tuberculosis,
 President's address (Charles H. Mayo), 601
 Intestinal movements, 231, 232
 obstruction, 242
 colostomy for, 249
 evacuation before resection, 269
 ileocecal resection for, 271
 in ascending colon, 271
 in descending colon, resection for, 272
 in hepatic flexure, resection for, 271
 in large intestine, 268
 in sigmoid, resection for, 272
 in small intestine, 270
 in splenic flexure, resection for, 272
 in transverse colon, resection for, 272
 localization of, 269
 resection for, 268
 colostomy preliminary to, 249
 evacuation before, 269
 fecal drowning in, 269
 of large intestine, 268
 of small intestine, 270
 septic peritonitis in, 269
 surgery of cecum and, 262
 vascular changes in, 269
 Intestine, embryology of, 206
 large, anastomosis of, methods, 245
 anatomy of, 231, 261
 appendices epiploicæ of, 241
 benign disease of, resection for, 254
 statistics, 259
 cancer of, embolic carcinoma of liver and, 240
 removal, 245
 digestion in, 231
 diverticulitis of, 294. See also *Diverticulitis of large intestine*.
 faulty bending of, 240
 fibromyoma of, intussusception from, 256
 Intestine, large, fossæ in connection with, 240
 general considerations, 231
 hemorrhage in wall of, 260
 in eleventh fetal week, 232
 intussusception of, 256
 length of, 236
 mobilization of, 243
 movements in, 231, 232
 obstruction of, 242. See also *Intestinal obstruction*.
 peridiverticulitis of, 297
 resection of, after-treatment, 273
 incision for, 243
 one hundred cases, 249-259
 statistics, 258
 surgery of, 231, 241
 catharsis before operation, 241
 review of cases, 231
 tuberculosis of, 256
 tumors of, 242
 nervous control of, 66
 small, resection of, 270
 after-treatment, 273
 storage function of, 206
 Intracranial versus peripheral operations for tic douloureux, 541
 Intussusception, 256
 after ileocecal anastomosis, 272
 Iodothyroglobulin, 509
 Irish linen suture material, 586
 Islands of Langerhans, 211

 JABOULAY's treatment of goiter, 438
 Jaundice, catarrhal, from pancreatic disturbance, 208
 in cholelithiasis, 72
 in duodenal ulcer, 72
 in pancreatitis, 211, 221
 Jejunum and gall-bladder, union between, 224
 Joints, Bier's hyperemia, 629, 632
 tuberculous, Bier's hyperemia for, 629, 632
 Jones' clinic at Liverpool, 608, 609
 Jonnesco's canal, 59, 197

- KIDNEY**, blood-vessels of, anomalous, hydronephrosis and, 392, 403.
See also *Hydronephrosis, anomalous renal blood-vessels and*.
pelvis of, capacity of, 401, 413
determining size of, 413, 414
dilatation of, 413
distention of, 401
nerve-supply of, 413
obstruction at, 411
size of, 401, 413
valve formation of, 393
prolapse, 236
reversion processes in, 525
tumor, ureteral obstruction from, 412
King's College Hospital, London, 615
Klappenmechanisms, 406
Knives, sterilization of, 585
Kocher's transverse-collar incision for thyroidectomy, 423, 439, 446, 512
Kraus' theory of cardiospasm, 35
- LANGERHANS' islands**, 211
Lanier-Hackermann point, 12
Larynx, cancer of, 551
Lead plate after gasserian removal, 546
Leeds, surgical work at, 613
Left colic artery, 239
Lenses for stereo-photography of pathologic specimens, 590
Leukocyte chart, Gibson's, 281
 Wilson's modification, 282, 283
 resistance-line, Sondern's, in appendicitis, 280
Leydig's cells, 217
Ligament of Treitz, 77
Ligation of blood-vessels in hyperthyroidism, 511, 512, 515
 after-care, 520
 anesthetic for, 519
 gland changes after, 520
 indications, 517, 518
 results, 521
 technic, 519
 of common carotids for hydrocephalus in infants, 611
Ligation of common carotids in tic douloureux, 542
 of external carotids in cancer of head, 550
Lip, cancer of, 3, 549. See also *Epileptoma of lip*.
 ulcer of, cancer and, 627
Lipoma, retroperitoneal, 348
 case, 350
 diagnosis, 349
 symptoms, 349
 treatment, 350
Liquid food, passage through esophagus, 36
Liver, biology of, 523
 cancer of, embolic, intestinal cancer and, 240
 embryologic origin, 102
 reversion processes in, 525
 round ligament of, cyst of, 228
 syphilis of, differential diagnosis, 192
Liverpool, as surgical center, 608
London as surgical center, 605, 614
 Hospitals, 614
Lymph drainage of colon, 239
- MACERATION** of food, 103
Makins' work at St. Thomas' Hospital, London, 615
Mayo's (Charles H.) method of treating tic douloureux, 545
 technic for bunion, 561
Mayo's (William J.) operation for umbilical hernia, 321, 322
 Ochsner's modification, 326
McGraw ligature in cholecystenterostomy, 226
Mears' treatment of tic douloureux, 543
Meckel's diverticulum, 232
Medical education in England, 607, 608
Mesocolic band, relation to gastroenterostomy, 76, 79
 hernia, 337
Messenger from duodenum, 524
Middle colic artery, 238
Midgut, derivatives of, 65, 206, 231

- Mikulicz's cholecystenterostomy, 224
 gastrojejunostomy, 86
 technic for cardiospasm, 30, 46
 treatment of goiter, 423, 440
 Mikulicz-Heinecke pyloroplasty in ulcer, 84
 technic in hydronephrosis with anomalous renal blood-vessels, 394
 Mikulicz-Jessett method for intussusception after anastomosis, 272
 Mikulicz-Paul method for obstruction at sigmoid, 273
 three-stage anastomosis, 246
 Mobilization of cecum and ascending colon, 263, 264
 of large intestine, 243
 of lower sigmoid, 244
 Möbius' sign in Graves' disease, 435
 theory of Graves' disease, 475
 Monks' technic for evacuating bowels before resection, 269
 Monprofit's cholecystenterostomy, 225
 Morison's clinic at Victoria Hospital, Newcastle, 613
 Motor nerves, impulse of, 542
 Mouth, epithelioma of, 549
 Moynihan's cholecystenterostomy, 224
 work at Leeds, 614
 Mullerian duct, failure of development, 391
 Murphy button in anastomosis, 270, 271, 272
 in cholecystenterostomy, 226
 in gastrojejunostomy, 84
 Myoma of bladder, 370, 377
 Myxedema, 526, 527
 in hyperthyroidism, 434, 435, 512, 534
 Myxofibrolipoma, retroperitoneal, 349
 Myxoma of bladder, 370, 377
- NARCOSIS, ether, signs of, 570
 National Hospital for Epileptics, London, 615
 Nausea in ulcer, 108
 Neck, cancer of, 547. See also *Cancer of neck*.
- Necrosis, fat, in pancreatitis, 208, 220
 Nephrocolic ligament, 236
 Nephrolithiasis, hydronephrosis and, differentiation, 398
 Nerve division in tic douloureux, 543
 regeneration of, 542
 stretching in tic douloureux, 543
 Nervous system, food storage and, 103
 Neuralgia, facial, 541. See also *Tic douloureux*.
 Neurosis, functional, gastric contents in, 137
 Newcastle-upon-Tyne, surgical work of, 613
 Nitrous oxid gas preliminary to ether, 567
 No-loop gastro-enterostomy, 76, 86
 for duodenal ulcer, 200
 hemorrhage, 100
 Nutrition, loss of, in cholelithiasis, 73
 in duodenal ulcer, 73
- OBSTRUCTION, intestinal. See *Intestinal obstruction*.
 Obturator, esophagoscopic, 45
 Ochsner's modification of Mayo's operation for umbilical hernia, 326
 Open method of ether anesthesia, 567
 Operating-room, economy in, 581
 force, 582
 in English hospitals, 607
 technic, 581
 Operation, catharsis before, 241
 Operator, preparation of, 585
 Orthopedic surgery in Liverpool, 608
 Osmic acid injections in tic douloureux, 542
 Osteomyelitis, Bier's hyperemia in, 632
 therapeutic, in ununited fracture, 554
 Ovarian cyst, hydronephrosis and, differentiation, 399
 Overlapping operation for umbilical hernia, 321, 322
- PACKS, 585
 sterilization of, 585

- Pain, Bier's hyperemia for, 630
 cause of, 630
 in cholelithiasis, 69
 in duodenal ulcer, 70
 swelling as cause, 630
- Pancreas, accessory lobes, to, 226
 anatomic relations, 215
 biology of, 523
 bleeding into, 208
 congenital anomalies of, 226
 embryologic derivation of, 102, 205, 206, 215
 fetal, 209
 functions of, 205, 214, 215
 importance of, 217
 relation of, 217, 218
 secretions of, 214, 215
 situation of, 205
- Pancreatic apoplexy, 208
 juice, 215
- Pancreatitis, acute, 208, 219
 fat necrosis in, 208, 220
 surgical treatment, 210, 219
 symptoms, 210
- Cambridge's test in, 212
 cholelithiasis with, cholecystenterostomy for, 213
 chronic, 210
 cholecystenterostomy in, 222, 224
 cholecystostomy in, 222
 course, 211
 from cholelithiasis, 210
 gall-bladder in, 221
 jaundice in, 211, 221
 surgical treatment, 221
 symptoms, 211
 from cholelithiasis, 205, 221, 222
 cholecystoduodenostomy for, 213
 cholecystostomy for, 213
 prognosis after operation, 212
 glycosuria in, 211
 hemorrhagic, 208
 interstitial, 210, 211
 course, 211
 subacute, 208
 surgical treatment, 220
 surgical treatment, 214
- Pancreatitis, triangle of, 208
- Papilloma of bladder, 369, 377
 diagnosis, 372
 etiology, 371
 malignancy of, 377, 378
 prognosis, 372
 recurrence, 377, 378
 results, 382
 suprapubic removal, 378
 symptoms, 371
 transperitoneal removal, 380
- Paralysis, cancer, 116
- Parathyroid question, 504
- Parathyroids, 420, 432, 504, 442
 adenoma of, 506
 anatomy of, 504
 cysts of, 506
 diseases of, 505
 external, 505
 feeding, 507
 function of, 505
 hemorrhage from, 505, 506
 inferior, 505
 internal, 505
 removal of, dangers of, 502
 effects, 505
 tetany after, 506, 507
 superior, 505
 surgical treatment of, 505, 506
 thyroidectomy and, 513
 tumors of, 506
- Paravicini's operation in tic douloureux, 543
- Pardoe's work at St. Peter's Hospital, London, 615
- Paronychia, Bier's hyperemia in, 631
- Parry's disease, 444. See also *Exophthalmic goiter*.
- Passive hyperemia, 629
- Paterson's work at Temperance Hospital, London, 615
- Pathologic specimens, stereo-photography of, 589
- Patient, position on table, 584
 preparation of, for operation, 583
 scrubbing of, 584
 soap for scrubbing, 584

- Pelvic examination in girls, 619
- in men, 619
- Pelvis of kidney, capacity of, 401, 413
 - determining size of, 413, 414
 - dilatation of, 413
 - distention of, 401
 - nerve-supply of, 413
 - obstruction at, 411
 - size of, 401, 413
 - valve formation of, 393
- Peptic ulcer of Cruveilhier, 96
 - round, 96
- Perforation, 108, 129, 198
 - gastrojejunostomy for, 83
 - of gastric ulcer, cases operated on for, 83
 - diagnosis, 172
 - surgical production, 199
- Peridiverticulitis of large intestine, pathology, 297
 - use of term, 307
- Peripheral versus intracranial operations for tic douloureux, 541
- Peristalsis, cause of, 66
- Peritoneal adhesions, 79, 80
 - cavity in fetus, 80
- Peritonitis, ether anesthesia in, 572
 - in appendicitis, Sondern's resistance-line in, 289
 - in ulcer, 108
 - septic, in intestinal obstruction, 269
- Pernicious anemia, gastric cancer and, differentiation, 118, 193
 - contents in, 137
 - ulcer and, differentiation, 193
- Pharyngeal diverticula, 12
- Pharyngo-esophageal diverticula, 12
 - cases, 17-20
 - diagnosis, 13
- Pharynx, cancer of, 551
- Phloridzin test in hydronephrosis, 399
- Photographs and drawings, relative value, 595
 - reproduction of, 595
- Physical examination, practical points in, 617
- Plea for early diagnosis and treatment of cancer, 623
- Plummer's esophageal sound, 16, 30, 44
 - method for diagnosing esophageal diverticula, 15
 - silk thread method in cardiospasm, 42
- Pneumonia, etherization, 573
- Polynuclear percentage in appendicitis, 280
- Pregnancy, goiter during, 434, 437, 443
- Preparation of assistants, 585
 - of field of operation, 584
 - of operator, 585
 - of patient for operation, 583
- Present-day surgery in England and Scotland, 605
- President's address (Charles H. Mayo), before International Congress on Tuberculosis, 601
- Pseudo-hyperthyroidism, 445
- Puberty, goiter at, 443
- Pulmonary tuberculosis, anesthesia in, 573
 - gastric disturbances in, 192
- Pulsating exophthalmic goiter, 445
- Pulse in chloroform anesthesia, 574
- Pulsion diverticula of esophagus, 11
 - of Zenker, 12
- Purging before examination, 620
- Pyloric canal of Jönnesco, 59, 197
 - spasm, 103
 - gastric contents in, 137
 - significance of, 64
 - ulcer and, 64
 - vein, 60
 - location of pylorus by, 61
- Pyloroplasty for duodenal ulcer, 84
 - for gastric ulcer, 84
 - Heinecke-Mikulicz, 84
- Pylorus, blood-vessels of, 60, 61
 - identification of, 61
 - location of, by blood-vessels, 61
 - stricture of, Finney's operation, 88, 92
- Pyrosis in gastric cancer, 189

- QUÉNU-Tuttle operation for sigmoid tumor, 248
- RADIOGRAPHY in cardiospasm, 29, 43
- Rapid preparation of fresh tissues for microscope, 579
- Rectal artery, superior, 240
examination, 617, 619
- Rectum, anatomy of, 235
and sigmoid, direct union between, 247
first portion of, 235, 240
reverse mucous currents of, 232
- Reflexes, testing of, 621
- Regeneration of nerves, 542
- Regurgitation of intestinal contents, drowning from, 243
- Renal colic, artificial, 401
- Reproduction of photographs, 595
- Resistance-line, Sondern's leukocyte, in appendicitis, 280
- Respiration in ether anesthesia, 569, 570
- Retrogastric hernia, 337
- Retroperitoneal fibrolipoma, 349
lipoma, 348
myxofibrolipoma, 349
- Reverse mucous currents of rectum, 232
- Right colic artery, 237
- Ring cancer, 162
- Robson's cholecystenterostomy, 224
work in London, 614
- Rodent ulcer of face, 548
- Rodman's excision with gastrojejunostomy, 91, 92
- Röntgen-ray diagnosis of hydronephrosis, 397
in cancer of face, 549
in goiter, 446
in Graves' disease, 436
- Round ligament of liver, cyst of, 228
peptic ulcer of Cruveilhier, 96
- Royal College of Surgeons of Edinburgh, 612
Infirmity of Edinburgh, 610, 612
- Rubber balloon for dilating cardia, 31, 46
- Rubber drainage-tubes, 587
tissue implantation in tic douloureux, 544, 545
- Rumpel's double sound in esophageal diverticula, 14, 15
- Russell's dilator for cardiospasm, 30, 46
- SADDLE ulcer, 89, 98
cancer and, differentiation, 119
- St. Peter's Hospital, London, 615
- St. Thomas's Hospital, London, 615
- Salivary glands, biology of, 523
- Salt solution injections in tic douloureux, 542
- Santorini's duct, 207
- Sarcoma of bladder, 370, 377
of cecum, 267
of thyroid, 437, 448, 502
- Scopolamin and morphin preliminary to ether, 567
- Secondary anemia, diagnosis, 622
- Secretin, 524
- Secretions, internal, 214, 527
- Sensory nerves, reunion of, 542
- Serum, thyroid, 436
- Serumtherapy of Graves' disease, 444
- Shutters for stereo-photography of pathologic specimens, 590
- Sigmoid, anatomy of, 234
and rectum, direct union between, 247
artery, 240
benign disease of, resection for, 257
cancer of, 253
resection for, statistics, 259
diverticulitis of, 294
clinical course, 308
surgical treatment, 296
fibrolipoma of, 257
lower, mobilization of, 244
resection of, for obstruction, 272
in pelvic diseases, 257
tuberculosis of, 257
tumors, abdominoperitoneal operation, 247
low-lying, 247

- Sigmoid tumors, perineal operation for, 248
 posterior operation for, 248
 Quénu-Tuttle operation for, 248
 vascular supply of, 240
- Silk thread method of diagnosing cardiospasm, 42
 esophageal diverticula, 15
- Silkworm-gut, 586
- Silver plate in gasserian removal, 546
 plugging of foramen of exit of nerve after resection for neuralgia, 545
- Skiagraphy in diverticula of esophagus, 14
- Soap for scrubbing patients, 584
- Sondern's differential leukocyte resistance-line, value of, in appendicitis, 280
- Sonnenberg's operation in tic douloureux, 543
- Sound, esophageal, Plummer's, 16, 30, 44
 Rumpel's, 14, 15, 16
 in diverticula of esophagus, 14, 15
- Southern Infirmary of Liverpool, 608
- Spasm of pylorus, 103
 gastric contents in, 137
 significance of, 64
 ulcer and, 64
- Splenic flexure, anatomy, 239
 cancer of, 252
 resection for, statistics, 258
 obstruction at, resection for, 272
- Splints, English, 610
- Sponges, 585
- Stellwag's sign in Graves' disease, 435
- Sterility of intestinal tract, 241
- Sterilization in England, 607
 of dressings, 585
 of gloves, 585
 of instruments, 585
 of knives, 585
 of packs, 585
 of suture materials, 586
- Stereo-photography of pathologic specimens, 589
- Stiles' clinic at Children's and Chalmers Hospitals, Edinburgh, 611
 treatment of hernia, 611
- Stomach and gall-bladder, union between, 225
 as storehouse, 102
 closure of excision defect to enlarge lumen, 99
 diseases of, cases operated on from 1893 to 1909, 82
 embryologic origin, 102
 hemorrhage from, 95. See also *Gastric hemorrhage*.
 hour-glass, 90, 92
 excision in, 100
 mucous erosion of, 96, 97
 nervous control of, 66
 outlining of, 109, 134
 ulcer of. See *Gastric ulcer*.
- Stomach-tube in cardiospasm, 41, 42
- Stools, bloody, 95, 96, 107
- Strauss' volume-measure after cardiospasm, 45
 in diverticula of esophagus, 14, 16
- Struma adenomatosa recurrens, 480
 parenchymatosa, 480
- Sublingual lymphatics, 551
- Submaxillary glands, 6
 lymphatics, 551
- Submental glands, 6
 lymphatics, 551
- Suction hyperemia, 629
- Suggestion in producing ether narcosis, 569
- Superior deep cervical lymphatics, 551
 rectal artery, 240
- Supraclavicular lymphatics, 551
- Suture for cholecystenterostomy, 226
 in anastomosis after resection for obstruction, 270
 materials, 586
 in England, 607
- Swelling as cause of pain, 630
- Sympathectomy for exophthalmic goiter, 438
- Synovitis, Bier's hyperemia in, 629, 632

- Syphilis, gastric cancer and, differentiation, 117
 of liver, differential diagnosis, 192
 of stomach, differential diagnosis, 192
- TACHYCARDIA in hyperthyroidism, 509
- Technic, 576
 histologic, 579
 of stereo-photography of pathologic specimens, improvements in, 589
 operating-room, 581
- Temperance Hospital, London, 615
- Testicles, secretory functions of, 217
- Test-meal in cardiospasm, 41
 in gastric cancer, 185
 diagnosis, value of, 131
 ulcer, 133
 technic, 133
- Tetany after goiter operation, 420, 425
 treatment, 506
 after parathyroidectomy, 506, 507
 experimental, 507
- Thiersch's torsion in removal of gas-serian ganglion, 543
- Thompson's clinic at Royal Infirmary and Deaconesses Hospitals, Edinburgh, 612
- Thoracotomy in diaphragmatic hernia, 344
- Thymus gland, development of, 442
- Thyrocele, 443
- Thyroid gland, accessory, 442
 adenoma of, 423, 437, 450, 463, 486, 487
 case, 469, 490
 fetal, 530, 536
 operation for, mortality, 499
 technic for, 512
 after ligation of vessels, 520
 anatomy of, 419, 430, 441, 524
 biology of, 524
 blood supply of, 420, 430
 cancer of, 437, 448, 502, 551
 capsule of, 419, 430, 441
 cysts of, 423, 437, 448, 535, 536
 cases, 489
- Thyroid gland, cysts of, operation for, mortality, 499
 development, 429, 441
 diseases of, 427, 428
 feeding, 442, 443
 fetal, 529
 hypertrophic, 536
 function of, 432, 442, 524
 generative organs and, connection, 443
 histology of, 529
 internal secretion and, 527
 nerve supply of, 420
 normal, 534
 histology of, 530
 stimulation of, 528
 pathologic changes in, in Graves' disease, 449, 474
 posterior capsule of, treatment of, in thyroidectomy, 419, 447
 primitive, 534
 round-cell infiltration in, 528
 sarcoma of, 437, 448, 502
 secretion of, 432
 septic conditions of, 443
 stimulation of, 535
 surgery of, 427
 treatment of posterior capsule of, in thyroidectomy, 419, 447
 tumor of, 421, 437, 443
 encapsulated, 448
 cases, 489
 mortality, 499
 removal of, 439
 serum, 436
- Thyroidea cystica, 535
 papillare, 536
 foetalis adenomatosa, 537
 hypertrophica, 536
 parenchymatosa hypertrophica, 536
- Thyroidectomy, after-care, 503, 513
 anesthesia for, 503, 513
 functional effects, 433
 hemorrhage in, mortality, 502
 in hyperthyroidism, 511, 512
 late results, 496
 mortality, 496, 498, 499

- Thyroidectomy, incision for, 512
 mortality, 448
 parathyroids and, 513
 partial, 480
 treatment of posterior capsule of gland in, 419, 447
- Thyrototoxicosis, 508
- Tic douloureux, Abbe's treatment, 544
 air injections in, 542
 Bennet's treatment, 542
 boiling water injections in, 542
 Desplat's treatment, 542
 drugs for, 541
 excision of sympathetic ganglions in, 542
 external applications for, 541
 Ferguson's treatment, 542
 intracranial operations for, 544
 ligation of common carotid in, 542
 Mayo's method, 545
 Mears' treatment, 543
 nerve division in, 543
 stretching in, 543
 operations for, peripheral versus intracranial, 541
 osmic acid injections in, 542
 Paravicini's operation in, 543
 peripheral operations for, 543
 removal of gasserian ganglion in, 543
 of gustatory nerve in, 545
 of nerves in, 543
 rubber tissue implantation in, 544, 545
 salt solution injections in, 542
 silver plugging of exit of foramen of nerve after resection, 545
 Sonnenberg's operation in, 543
 Wyeth's treatment, 542
- Tongue, epithelioma of, 549, 551
- Toxin production in goiter, 526
- Trachea, injury to, during goiter operation, 424
- Traction diverticula of esophagus, 11
- Traction-pressure diverticula of esophagus, 11
- Transplantation of cord in inguinal hernia, 335
- Transverse colon, anatomy of, 236
 benign disease of, resection for, 257
 cancer of, 249, 252
 resection for, statistics, 258
 obstruction at, resection for, 272
- Transverse-collar incision in epithelioma of lip, 4, 8
 in goiter, 423, 439, 446, 512
- Treitz's ligament, 77
- Trendelenburg position, ether anesthesia in, 572
- Triangle of pancreatic inflammation, 208
- Trigeminal nerve, removal of, 543
- Tuberculosis, acidity and, 132
 gastric cancer and, differentiation, 118
 disturbances in, 192
- International Congress on, President's address (Charles H. Mayo), 601
 Mayo's Presidential address on, 601
 of appendix, 257
 of cecum, 260
 of ileocecum, 256
 of joints, Bier's hyperemia in, 629, 632
 of large intestine, 256
 of sigmoid, 257
 of ureter, 410
 pulmonary, anesthesia in, 573
- Tumor in left side, 294
 in ulcer cases, 109
 of bladder, 355. See also *Bladder, tumor of*.
 of breast, 363. See also *Breast, tumor of*.
 of cecum, 260. See also *Cecum, tumors of*.
 of large intestine, 242
 of sigmoid, abdominoperitoneal operation for, 247
 low-lying, 247
 perineal operation for, 248
 posterior operation for, 248
 Quénu-Tuttle operation for, 248
 Turner's work at Newcastle, 613

- ULCER, duodenal. See *Duodenal ulcer*.
 gastric. See *Gastric ulcer*.
 of lip, cancer and, 627
 rodent, of face, 548
 Umbilical hernia, 321. See also *Hernia*,
 umbilical.
 Ununited fractures, 553. See also
 Fractures, ununited.
 Ureteral catheter, data acquired with,
 408
 Ureters, constriction of, 412
 cystic dilatation of, 411
 identification of, 244, 265
 in hydronephrosis, 411
 obstruction in, 409
 stone in, 410
 tuberculous ulceration of, 410
 Urongenital system, unilateral absence
 of, 385
 pathology, 388
 Uterus, cancer of, early treatment, 626

 VAGINAL examination in girls, 619
 Valve formation of pelvis of kidney, 393
 Valvulæ conniventes, 102
 Vasa deferentia, identification of, 244
 Vater's ampulla, 207
 Venous artificial hyperemia, 629
 Victoria Hospital of Newcastle, 613

 Voice loss in goiter, 437
 Volume-measure test of Strauss in car-
 diospasm, 45
 in esophageal diverticula, 14, 16
 Vomiting in cholelithiasis, 71
 in duodenal ulcer, 71
 in gastric cancer, 54, 56, 115, 116,
 184, 189
 ulcer, 54, 56, 170, 108
 von Graefe's symptom in Graves' dis-
 ease, 435
 Von Schmieden's treatment for un-
 united fracture, 554
 V-shaped incision for epithelioma of lip,
 9

 WALLACE's work at Edinburgh, 612
 Whalebone staff with drilled olive, 39
 with spiral tip and olive, 39
 Wilson's modification of Gibson's leuko-
 cyte chart, 282, 283
 Wirsung's duct, 207
 Wolffian duct, failure of development of,
 391
 Wyeth's treatment of tic douloureux,
 542

 ZENKER's pulsion diverticulum of esoph-
 agus, 12

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